MOBILE PHONE REPAIRING

(TRAINEE MANUAL)



PUNJAB VOCATIONAL TRAINING COUNCIL

FOREWORD

Punjab Vocational Training Council (PVTC) has been established since June 1998. The prime objective of PVTC is to set up, regulate and manage the Vocational Training Institutes (VTIs') for imparting skills. The philosophy behind the establishment of VTIs' is to alleviate poverty with Zakat funds by providing demand driven skills to the needy and the Mustahqeen. The VTIs' are managed by Boards consisting of prominent members of the local community, the potential employers.

PVTC has developed curricula for various trades and levels to meet requirements of industrial, agriculture and service sectors. Pakistan needs skilled manpower to boost industrial productivity as the competition in market need to cut the costs. A skilled industrial worker can bring substantial changes in the traditional methods of production and can help to maintain the account also.

Over the last few years, mobile phones have become a more and more widespread means of communication. They have become a part of everyday life with ever more people enjoying the service and extra freedom they provide.

In some countries mobile communication is the only way to use telecommunications, as their standard telecommunication network has not yet been extended to encompass the whole population.

For many disabled and elderly people, the support they receive through the mobile phone may be the reason that they feel secure enough to cope on their own. A blind person who gets lost can call for help, a person who easily gets lost can be called by others to make sure they are all right, wheelchair users can go into the countryside and still be able to get help etc. Furthermore, new developments such as the Universal Mobile Telecommunication System (UMTS) are opening up new applications for these people and their carers.

These examples illustrate the importance of mobile phones in lives of a growing number of people and underline how essential it is that this technology can be used by as many people as possible.

That is the reason that a mobile phone repair course is being introduced in VTI's keeping in view the market demand of mobile phone worker.

These curricula have been prepared with active participation of Boards of Management (BOMs) and instructional staff of VTIs, keeping in view the latest technological development in the field. It will serve the purposes of providing guidance and direction to the instructional staff of VTIs to impart uniform and standardized training.

My sincere thanks are due to the followings all who have contributed in the development of this curricula.

1. Muhammad Shakil, Manager Curriculum, PVTC Lahore.
2. Abdul Waheed, Principal, VTI Township Lahore.
3. Shahid Saleem, Senior Instructor, VTI Township Lahore.
4. Department of IT, Govt. College of Technology, Railway Road, Lahore.
5. Eng. Zafar Abbas Malik, Labour Officer, Directorate of Labour and Manpower, Govt. of Punjab.

I am confident it will go a long way towards overall improvement of the standards of skill training in the days to come.

Updating the curricula is a continuous process to keep it in line with the development in Technology and requirements of labor market. Therefore, suggestions for improving this curriculum are most welcome.

Sikandar M. Khan
Chairman
Punjab Vocational Training Council

Lahore
Feb, 2005

TRAINING PROGRAM

1. Needs / Objectives.

At the end of the training, trainee will be able to repair the various types and brands of cell (mobile) phones i.e. AMPS, GSM.

The trainee will learn the followings:-

1. Basics of electricity
2. Basics of electronics
3. Use of electronic testing equipments such as:-
   - (a) Power supply
   - (b) Oscilloscope
   - (c) Ammeters, Voltmeters, Watt meters.
   - (d) Digital power supply
   - (e) Multi meter
4. Use of electronic repair instruments /materials such as.
   - (a) Soldering iron
   - (b) Soldering paste
   - (c) Hot air station
   - (d) Lamp
   - (e) Tool kit
   - (f) Board gripper
   - (g) Solder sucker

5- Assembling & dissembling of different mobile phone sets.
6- Troubleshooting and repair of cell phone.
7- Installation of software in cell phones.
8- Replacement of parts.
9- Cleaning and polishing.
10- Downloading of different ring tones.

2. Skill Requirements

At the end of the course , the trainee will be able to perform following tasks .

1. Observe safety rule while dealing with electronic circuits.
2. Complete know how to basic electronic by which one can be skilled.
3. Use of measurement & test equipments, safely and accurately.
4. Expertly dissemble and assemble mobile sets.
5. Reading of circuits diagrams of mobile sets.
6. Diagnose & remove faults in mobile sets.
7. Replace defective parts /components.
8. Downloading and installation of softwares.
9. Understand the marketing techniques.

3. Knowledge Requirements.

After the Completion of course the pass out would have the knowledge of

1) Safety precautions , personals & equipment
2) Precisely using and careful handling of tools and plants.
3) Basic knowledge of
    a. Electricity
    b. Current flow
    c. conductors and insulators
    d. AC & DC Supply
    e. Ohm,s law
    f. Measuring units
    g. Open close and short circuits
    h. Electromagnetism.
    i. Frequency, band width, wavelength, analog &digital signal and mathematical relationship.
    j. Symbols and colors used in electronics.
    k. Radio frequencies , A.M and F.M details.
    l. Working and connection with the cell station
    m. Master and slave cells
    n. Mobiles phone display properties
    o. Touch system working
    p. Transmission, receiving and flow
    q. Permanent and temporary memory
    r. Security setting
    s. Networking setting
    t. Battery charging & discharging mechanism.
    u. TDMA, FDMA, CDMA,
    v. Blue tooth, GPRS, IRDA & Griffin.

4. Entry Level

- Matric (Preferably with science).
- Admission is subject to passing a general aptitude test.

5. Class Size

- 20-25 Trainees

6. Training Duration / Scheme

a)	VTI Training	-6 months (theory & practical)
b)	On job training	-2 months
c)	No. of hours per week	-40
d)	Ratio (Theory to Practical)	-20:80
e)	Training material	– Trainee/instruction manual , work book
f)	Medium of Instructions	– English
g)	Method of Instructions	– Lectures, demonstration practical
h)	Tests	– Quizzes, Monthly, Final
i)	Evaluation	– Attendance, seasonal, final test OJT

j) Qualification and training level of staff:

-Jr.Instructor –B.Sc Telecommunication engineering or DAE in Telecommunication with 3 years experience, or certificate in telecom. with 8 years experience.

- Lab Assistant –certificate in telecommunication with 3 years experience.

7. Employability

The Pass out of this course will be able to work in the following positions.

- Work with mobile phone operator
- Work with mobile phone repairing workshop
- Self employed by having his own mobile phone repairing shop
- Salesmanship with mobile phone company

8. List of Machinery / Equipments /Tools.

Sr. No	**Name**	**Quantity**
1	Multimeter (analog / digital)	5
2	Power supply (Digital)	5
3	Computers (P-IV)	2
4	Screw driver kit for Mobiles	20
5	Soldering gun.	10
6	Software cables (different types)	4 sets
7	Flasher / Un lockers software for all mobiles.	2
8	Hot air station	5
9	AIMS sets of different companies.	5+5
10	GSM set of different companies	10+10
11	Air blower	5
12	Cleaning brush (small)	20
13	Additional chargers (different types)	10
14	Magnifying glass	10
15	Soldering sucker	10

9. List of Consumables

S. No	Name	Quantity
1	Wire for Connection	5 meter each
2	Soldering material	As required
3	Duster	20

10. COURSE CONTENTS / OUTLINE

(A)

Sr. No.	Topic	Training Hours	
		Theory	Practical
1	**BASIC ELECTRONICS** Electricity Fundamental Current & Voltage Resistance Coulomb Ohm's Law Magnetism Open & Close Circuit Parallel & Series Circuits Resistor Capacitor Diode Transformer Transistor Semi Conductors Fuse Voltage Regulators Analog and Digital Concepts Digital Logics Circuits Relays Counters Measuring Tools/Equipments Volt meter Ammeter Multi meter Oscilloscope	40	140
2	**SOLDERING AND MEASUREMENT TECHNIQUES** Introduction to Soldering Simple Soldering Hot Air Station Soldering BGA IC & Chips Soldering PA Soldering CPU & TX Soldering Introduction to Measurement Voltage measurement Current Measurement Resistance measurement Power Measurement Use of Oscilloscope	20	100
3	**HISTORY OF COMMUNICATION** History of Cellular System First Generation Network Second Generation Network Third Generation Network Fundamentals of Cellular Systems	10	50
4	**MOBILE COMMUNICATION SYSTEMS** Cellular System Infrastructure Cellular Frequency Cell / Sector terminology Cell Phone Theory and Operation	20	80

	Handoff and central control Cellular geometry and system design Transmission Channels Call Organization Process Making Call Process Registration Roaming		
5	**CELLULAR ACCESS TECHNOLOGIES** Introduction Concepts and Models FDMA, TDMA CDMA TDMA/GSM Synchronization Modulation Techniques	10	50
6	**MOBILE PHONE STRUCTURE** Analog and Digital Mobile Cell Phone Mobile Phone Model identifications Cell Phone code Components of Mobile Phone AMPS & GSMS sets	20	70
7	**BASIC TROUBLESHOOTING OF CELL PHONES** Problems with Batteries Failed Connections and Drop Calls Ranges and Gaps in Services SMS Introduction Support and Troubleshooting Bluetooth Troubleshooting Basic Troubleshooting Mobile Phone Beeps	20	100
8	**MOBILE PHONE & COMPUTER SYSTEMS** Net Surfing Connectivity Downloading and Uploading	10	50
9	**TIPS, SECRETS AND FAQs** Unlocking Mobile Phones Codes Samsung Nokia Siemens etc Lock / Unlock Procedures FAQs Marketing	20	100
	Total	170	740

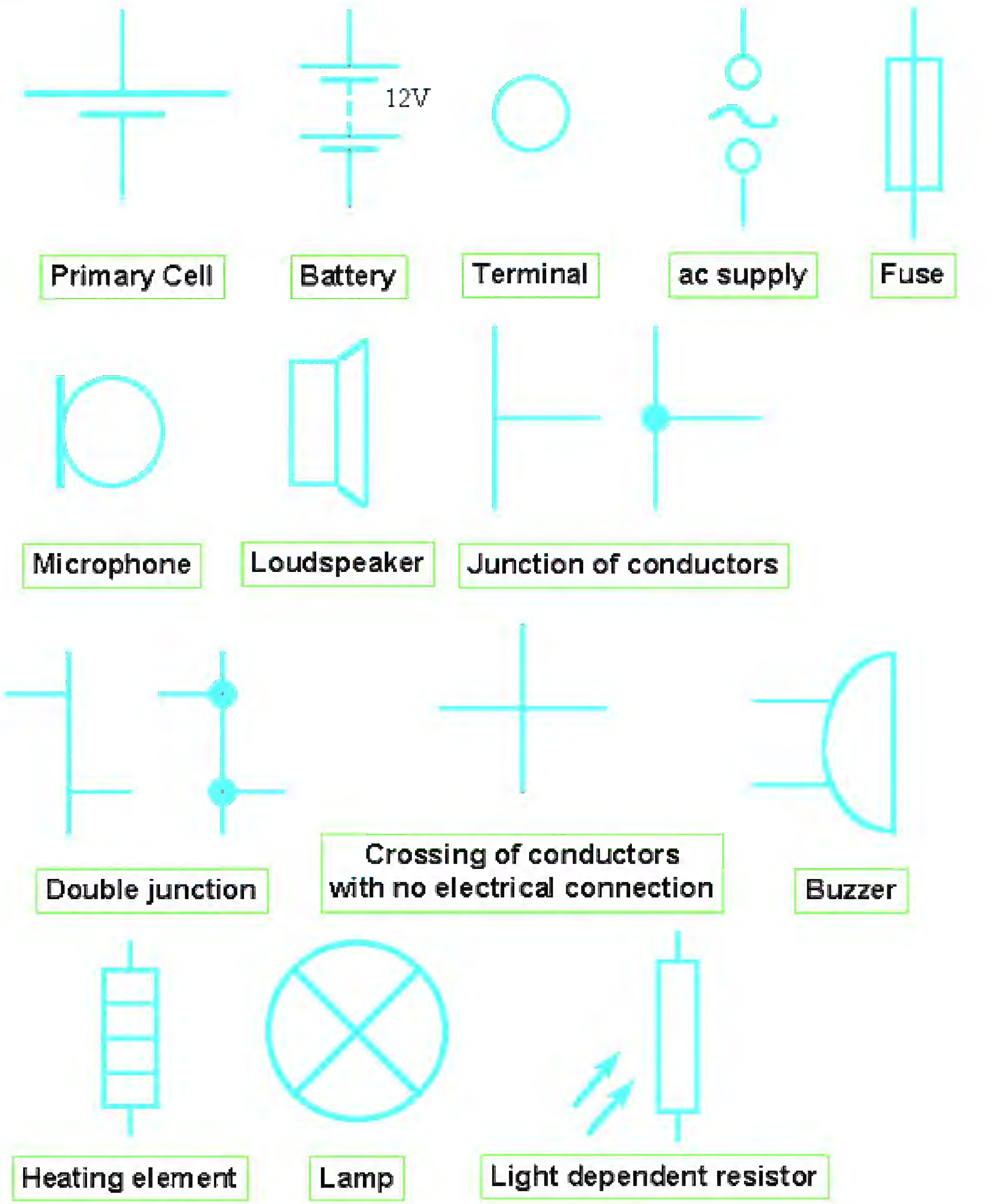
(B)

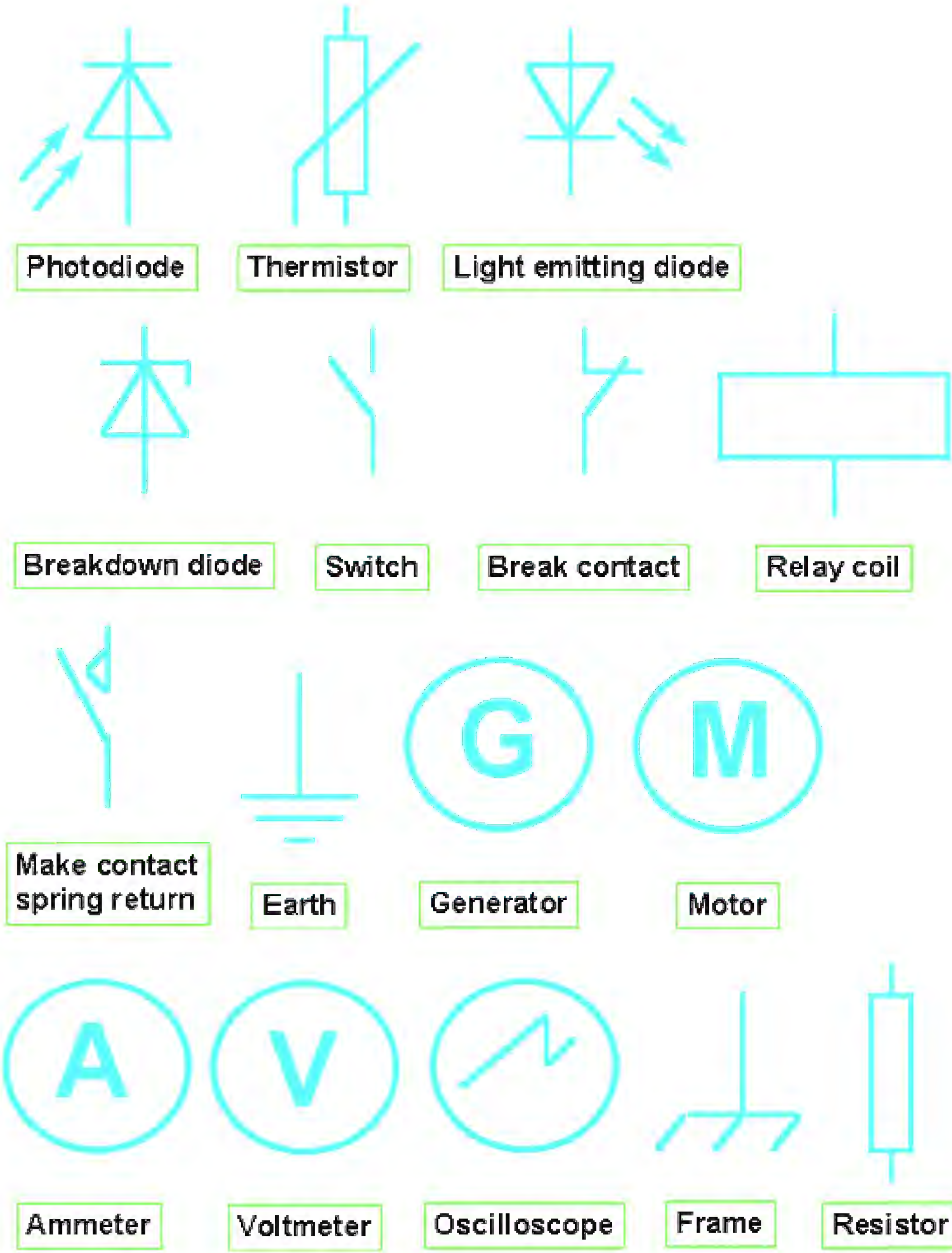
Common Course …………………………50

Total A+B=910+50=960

CONTENTS

Electronics Symbols




Photodiode
Thermistor
Light emitting diode
Breakdown diode
Switch
Break contact
Relay coil
Make contact spring return
Earth
G
Generator
M
Motor
A
V
Ammeter
Voltmeter
Oscilloscope
Frame
Resistor



Variable



Potentiometer



Capacitor



Polarised



pre-set adjustment



Schmitt inverter



Operational amplifier



PNP transistor



NPN transistor



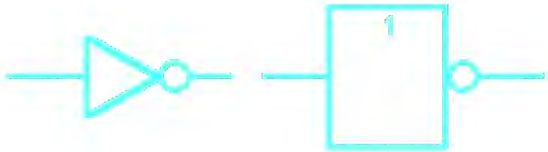
Aerial



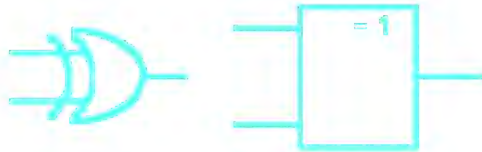
AND



NAND



NOT (Inverter)



EOR (Exclusive OR)



OR



NOR



RS- bistable



Inductor with magnetic core



Transformer with magnetic core

Basic Electronics

Electricity Fundamentals

To begin at the very beginning, all electric circuits require two wires to operate. Unlike water that simply flows from here to there, electricity requires a return path back to the original source. This is why a battery has two terminals and a 220 volt floor lamp has two wires. If you interrupt either wire the flow of electricity will stop, which is of course the basis for a switch, the most primitive of all components.

Current

An electric circuit is formed when a conductive path is created to allow free electrons to continuously move. This continuous movement of free electrons through the conductors of a circuit is called a current, and it is often referred to in terms of "flow," just like the flow of a liquid through a hollow pipe.

Voltage

The force motivating electrons to "flow" in a circuit is called voltage. Voltage is a specific measure of potential energy that is always relative between two points. When we speak of a certain amount of voltage being present in a circuit, we are referring to the measurement of how much potential energy exists to move electrons from one particular point in that circuit to another particular point. Without reference to two particular points, the term "voltage" has no meaning.

Resistance

Free electrons tend to move through conductors with some degree of friction, or opposition to motion. This opposition to motion is more properly called resistance. The amount of current in a circuit depends on the amount of voltage available to motivate the electrons, and also the amount of resistance in the circuit to oppose electron flow. Just like voltage, resistance is a quantity relative between two points. For this reason, the quantities of voltage and resistance are often stated as being "between" or "across" two points in a circuit.
Here are the standard units of measurement for electrical current, voltage, and resistance:

Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere ("Amp")	A
Voltage	E *or* V	Volt	V
Resistance	R	Ohm	Ω

Coulomb

One foundational unit of electrical measurement, often taught in the beginnings of electronics courses but used infrequently afterwards, is the unit of the coulomb, which is a measure of electric charge proportional to the number of electrons in an imbalanced state. One coulomb of charge is equal to 6,250,000,000,000,000,000 electrons. The symbol for electric charge quantity is the capital letter "Q," with the unit of coulombs abbreviated by the capital letter "C." It so happens that the unit for electron flow, the amp, is equal to 1 coulomb of electrons passing by a given point in a circuit in 1 second of time. Cast in these terms, current is the rate of electric charge motion through a conductor.

Ohm’s Law

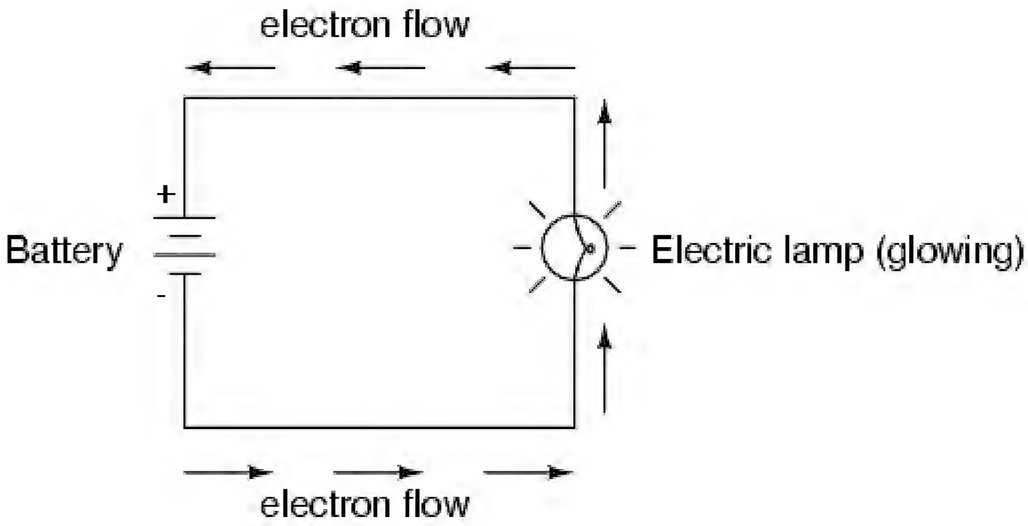
The amount of electric current through a metal conductor in a circuit is directly proportional to the voltage impressed across it, for any given temperature. Ohm expressed his discovery in the form of a simple equation, describing how voltage, current, and resistance interrelate:

$$E = I R$$

In this algebraic expression, voltage (E) is equal to current (I) multiplied by resistance (R). Using algebra techniques, we can manipulate this equation into two variations, solving for I and for R, respectively:

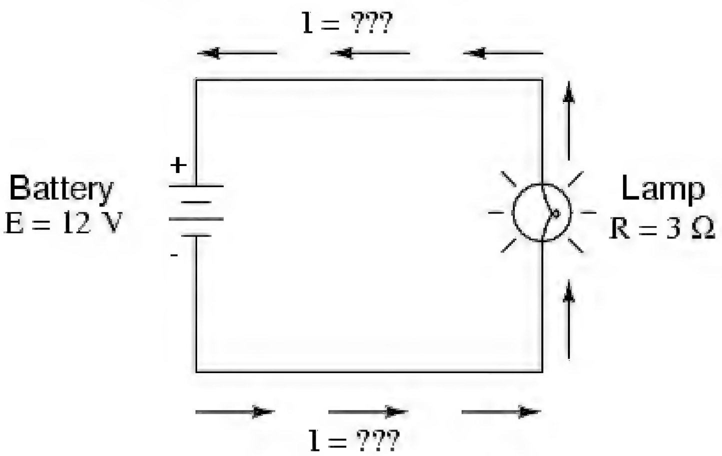
$$I = \frac{E}{R} \qquad R = \frac{E}{I}$$

Let's see how these equations might work to help us analyze simple circuits:



In the above circuit, there is only one source of voltage (the battery, on the left) and only one source of resistance to current (the lamp, on the right). This makes it very easy to apply Ohm's Law. If we know the values of any two of the three quantities (voltage, current, and resistance) in this circuit, we can use Ohm's Law to determine the third.

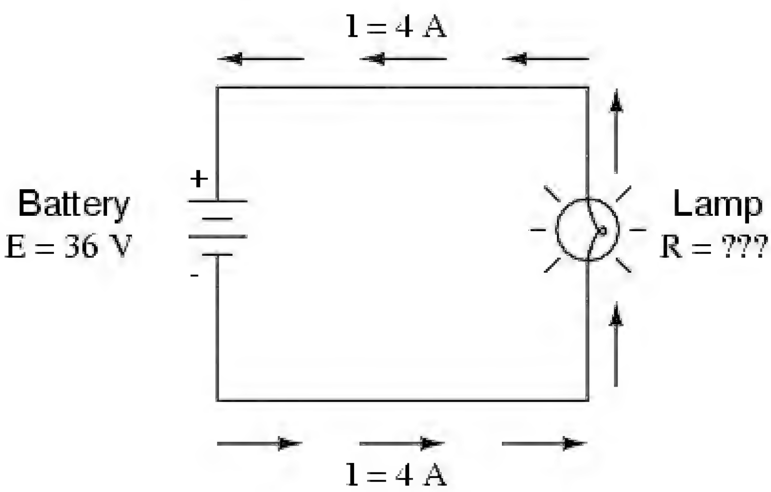
In this first example, we will calculate the amount of current (I) in a circuit, given values of voltage (E) and resistance (R):



What is the amount of current (I) in this circuit?

$$I = \frac{E}{R} = \frac{12\ V}{3\ \Omega} = 4\ A$$

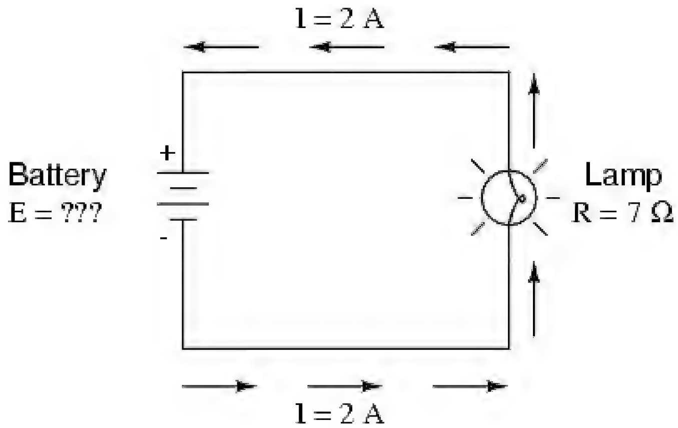
In this second example, we will calculate the amount of resistance (R) in a circuit, given values of voltage (E) and current (I):



What is the amount of resistance (R) offered by the lamp?

$$R = \frac{E}{I} = \frac{36\ V}{4\ A} = 9\ \Omega$$

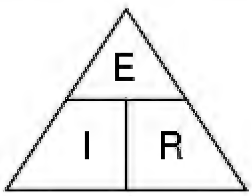
In the last example, we will calculate the amount of voltage supplied by a battery, given values of current (I) and resistance (R):



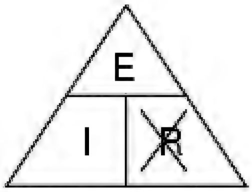
What is the amount of voltage provided by the battery?

$$E = IR = (2\ A)(7\ \Omega) = 14\ V$$

Ohm's Law is a very simple and useful tool for analyzing electric circuits. It is used so often in the study of electricity and electronics that it needs to be committed to memory by the serious student. For those who are not yet comfortable with algebra, there's a trick to remembering how to solve for any one quantity, given the other two. First, arrange the letters E, I, and R in a triangle like this:

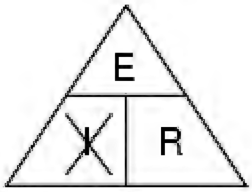


If you know E and I, and wish to determine R, just eliminate R from the picture and see what's left:



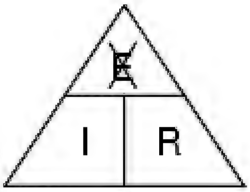
$$R = \frac{E}{I}$$

If you know E and R, and wish to determine I, eliminate I and see what's left:



$$I = \frac{E}{R}$$

Lastly, if you know I and R, and wish to determine E, eliminate E and see what's left:



$$E = I\,R$$

Eventually, you'll have to be familiar with algebra to seriously study electricity and electronics, but this tip can make your first calculations a little easier to remember. If you are comfortable with algebra, all you need to do is commit E=IR to memory and derive the other two formulae from that when you need them!

Magnetism

Magnetism and magnetic fields

A phenomenon apparently unrelated to electricity is magnetism. We are familiar with magnetism through the interaction of compasses with the earth's magnetic field, or through fridge magnets or magnets on children's toys. Magnetic forces are explained in terms very similar to those used for electric forces:

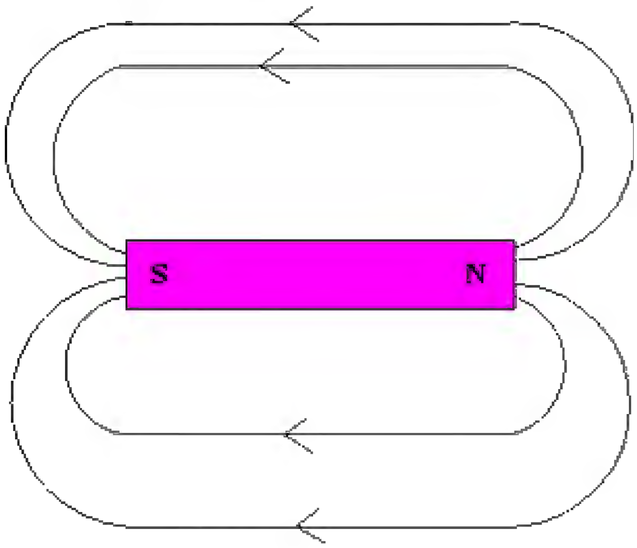
- There are two types of **magnetic poles**, conventionally called North and South
- Like poles repel, and opposite poles attract

However, magnetism differs from electricity in one important aspect:

- Unlike electric charges, magnetic poles always occur in North-South pairs; there are no **magnetic monopoles**.

As in the case of electric charges, it is convenient to introduce the concept of a **magnetic field** in describing the action of magnetic forces. Magnetic field lines for a bar magnet are pictured below.

Magnetic field lines of a bar magnet



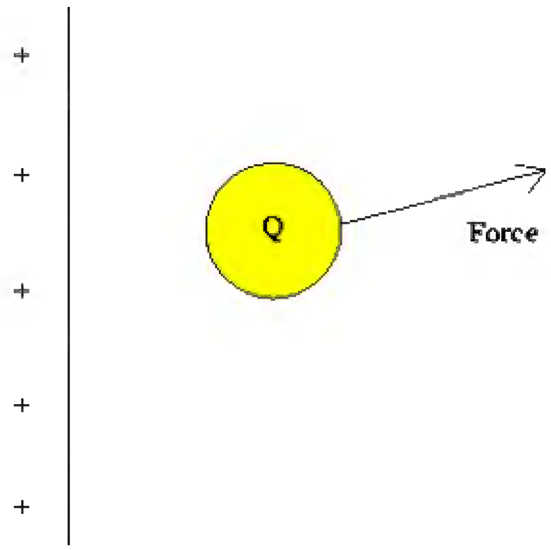
One can interpret these lines as indicating the direction that a compass needle will point if placed at that position.

Electric & Magnetic fields

Electric field

A convenient concept for describing electric forces is that of an **electric field**. Imagine that we have a fixed distribution of charges, such as on the plate below, and bring in the vicinity of this distribution a *test charge Q*.

Test charge in the presence of a fixed charge distribution



This charge will experience a force due to the presence of the other charges. One defines the electric field of the charge distribution as

Force on Q = (charge on Q) x (Electric field at Q)

The electric field is a property of this fixed charge distribution; the force on a different charge Q' at the same point would be given by the product of the charge Q' and the *same* electric field. Note that the electric field at Q is always in the same direction as the electric force.

Because the force on a charge depends on the magnitude of the charges involved and on the distances separating the charges, the electric field varies from point to point, both in magnitude and direction. By convention, the direction of the electric field at a point is the direction of the force on a *positive* test charge placed at that point. An example of the electric field due to a positive point charge is given below.

Open & Close Circuit

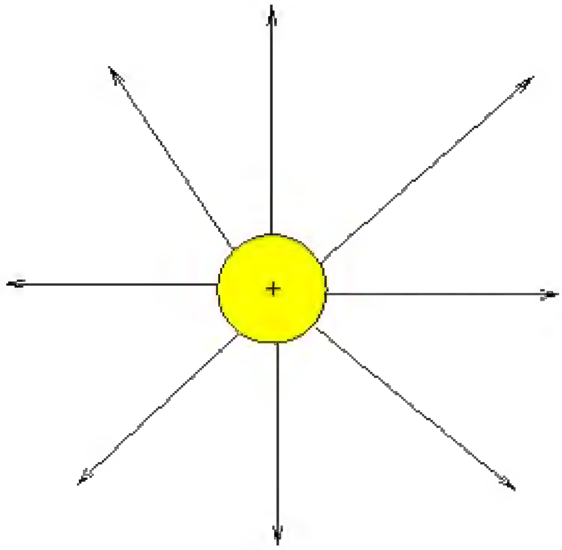
An incomplete electrical circuit in which no current flows is called open circuit.
A complete electrical circuit around which current flows or a signal circulates is called Close circuit.

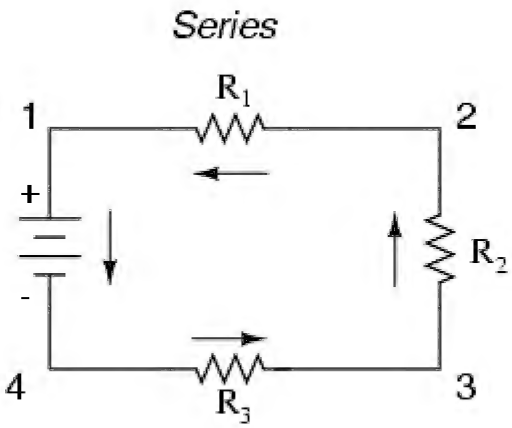
Parallel & Series Circuits

What are "series" and "parallel" circuits?

Circuits consisting of just one battery and one load resistance are very simple to analyze, but they are not often found in practical applications. Usually, we find circuits where more than two components are connected together.
There are two basic ways in which to connect more than two circuit components: series and parallel. First, an example of a series circuit:

Electric field lines of a positive charge

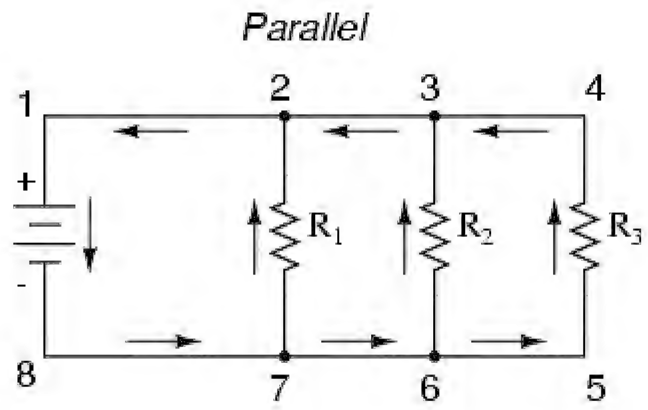




Here, we have three resistors (labeled R_1, R_2, and R_3), connected in a long chain from one terminal of the battery to the other. (It should be noted that the subscript labeling -- those little numbers to the lower-right of the letter "R" -- are unrelated to the resistor values in ohms. They serve only to identify one resistor from another.) The defining characteristic of a series circuit is that there is only one path for electrons to flow. In

this circuit the electrons flow in a counter-clockwise direction, from point 4 to point 3 to point 2 to point 1 and back around to 4.

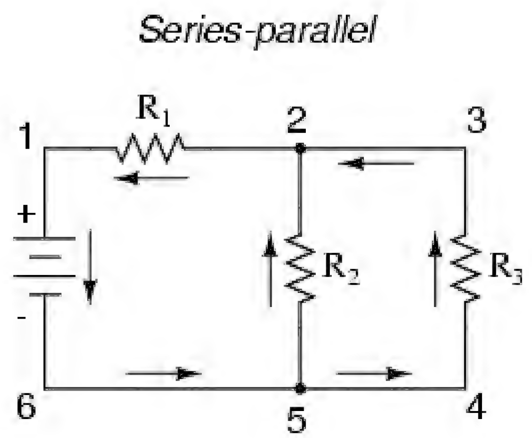
Now, let's look at the other type of circuit, a parallel configuration:



Again, we have three resistors, but this time they form more than one continuous path for electrons to flow. There's one path from 8 to 7 to 2 to 1 and back to 8 again. There's another from 8 to 7 to 6 to 3 to 2 to 1 and back to 8 again. And then there's a third path from 8 to 7 to 6 to 5 to 4 to 3 to 2 to 1 and back to 8 again. Each individual path (through R_1, R_2, and R_3) is called a *branch*.

The defining characteristic of a parallel circuit is that all components are connected between the same set of electrically common points. Looking at the schematic diagram, we see that points 1, 2, 3, and 4 are all electrically common. So are points 8, 7, 6, and 5. Note that all resistors as well as the battery are connected between these two sets of points.

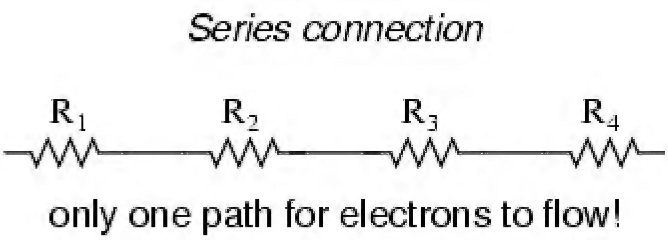
And, of course, the complexity doesn't stop at simple series and parallel either! We can have circuits that are a combination of series and parallel, too:



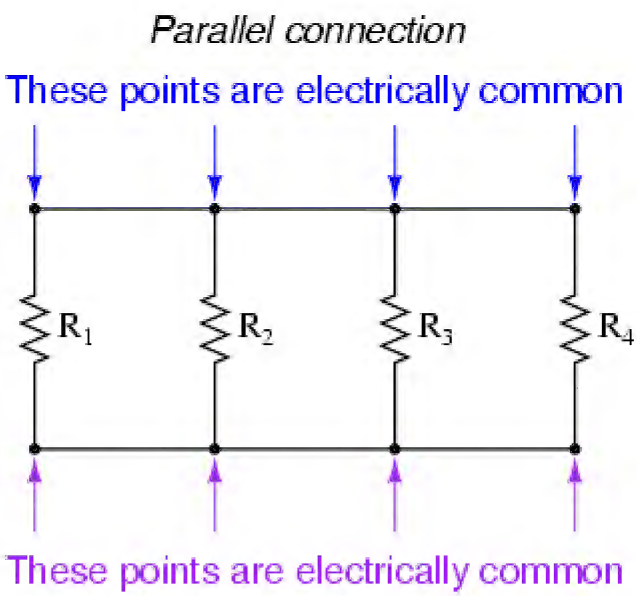
In this circuit, we have two loops for electrons to flow through: one from 6 to 5 to 2 to 1 and back to 6 again, and another from 6 to 5 to 4 to 3 to 2 to 1 and back to 6 again. Notice how both current paths go through R_1 (from point 2 to point 1). In this configuration, we'd say that R_2 and R_3 are in parallel with each other, while R_1 is in series with the parallel combination of R_2 and R_3.

This is just a preview of things to come. Don't worry! We'll explore all these circuit configurations in detail, one at a time!

The basic idea of a "series" connection is that components are connected end-to-end in a line to form a single path for electrons to flow:



The basic idea of a "parallel" connection, on the other hand, is that all components are connected across each other's leads. In a purely parallel circuit, there are never more than two sets of electrically common points, no matter how many components are connected. There are many paths for electrons to flow, but only one voltage across all components:



Series and parallel resistor configurations have very different electrical properties. We'll explore the properties of each configuration in the sections to come.

Chapter 1

Components of Electronic

Resistors

Lots of times, an on/off switch is sufficient, but what if you'd like to be able to vary the brightness? This is where resistors come in. A resistor is a component that is meant to be inserted into an electrical path, to restrict the flow of electricity. To continue the water analogy, a resistor is very much like a short length of narrow pipe. Most resistors come with two connecting wires, one at each end, so they can be added to the circuit. There are also variable resistors such as the volume control on a portable radio, and they operate much like a water valve or faucet.
The value of a resistor is measured in Ohms, and the higher this value is, the less current will be able to flow through it. When a resistor is inserted into either of the wires that connect a battery to a light bulb, less current is passed and the bulb will be dimmer. By the way, most of the resistors that you will encounter are constructed of some type of carbon material. In high power circuits, thin wire is generally used instead, which is then wound on a ceramic core that won't melt.
How to read Resistor Color Codes

First the code

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Gray	White
0	1	2	3	4	5	6	7	8	9

The mnemonic

Bad Boys Ravage Only Young Girls but Violet Gives Willingly *
Black is also easy to remember as zero because of the nothingness common to both.

How to read the code

First find the tolerance band, it will typically be gold (5%) and sometimes silver (10%).
Starting from the other end, identify the first band - write down the number associated with that color; in this case Blue is 6.

Now 'read' the next color, here it is red so write down a '2' next to the six. (You should have '62' so far.)
Now read the third or 'multiplier' band and write down that number of zeros.
In this example it is two so we get '6200' or '6,200'. If the 'multiplier' band is Black (for zero) don't write any zeros down.
If the 'multiplier' band is Gold move the decimal point one to the left. If the 'multiplier' band is Silver move the decimal point two places to the left. If the resistor has one more band past the tolerance band it is a quality band.
Read the number as the '% Failure rate per 1000 hour' this is rated assuming full wattage being applied to the resistors. (To get better failure rates, resistors are typically specified to have twice the needed wattage dissipation that the circuit produces) 1% resistors have three bands to read digits to the left of the multiplier. They have a different temperature coefficient in order to provide the 1% tolerance.

Capacitors

Capacitors are slightly more difficult to understand than resistors because there is no physical connection through them, though some types of current can still get through. But how can this be if there is no metal or other conductor? Before answering this question, let's first digress for a moment and consider the difference between alternating current (AC) and direct current (DC).
Direct current is the type of electricity you'd think of when using the water comparisons. That is, the current flows in only one direction. But with an alternating current, the direction is instead constantly changing. For the electrical circuits in your home, the direction alternates exactly sixty times per second. With audio (or radio) circuits, the range of frequencies is much greater.
Now let's see if we can find a suitable mechanical equivalent for a capacitor. How about a leaky bicycle pump? The type of pump I'm referring to consists of a plunger that is placed within a hollow metal tube. Now imagine that the plunger is not very well sealed, perhaps because it's a bit undersized. If you push the plunger very slowly, almost all of the air will leak back out. But if you increase the frequency of the pumping, less air will escape compared to the amount that travels the intended path. And if you give the pump a single fast push, some pressure will be developed though in a few moments it will dissipate.
In a similar manner, a capacitor allows electricity to flow, but only so long as the voltage is changing. Though there's no physical connection through it, a light bulb attached to a battery through a capacitor will flash briefly when they are first connected together. The whole point of capacitors, therefore, is that alternating currents can pass through them, while direct currents cannot. Further, the higher the frequency or rate of change, the more current will be able to get through. It's not hard

to see how capacitors are valuable in the design of the treble and bass controls on your stereo receiver.

Internally, a capacitor consists of two pieces of metal in close proximity, but not quite touching. If you can picture a piece of plastic food wrap sandwiched between two strips of aluminum foil, you're getting the general idea. A wire is attached to each strip of foil, and the whole thing is rolled up to save space and then dunked into go that hardens. If you haven't done this, I recommend buying an assortment of resistors, capacitors, and other components at Radio Shack, just to bust them open and see what's inside. This is not only quite educational, but a lot of fun as well.

Besides allowing a circuit to pass only higher frequencies, capacitors are also useful for their storage capability. In fact, a capacitor is not unlike a rechargeable battery, since it can also hold a charge. But that's another issue we will discuss later. By the way, the larger a capacitor's metal surfaces are, or the closer they are together, the higher its capacitance will be.

The value of a capacitor is measured in Farads, though you'll probably never see one that large. Similarly, you won't find a one Ohm resistor very often either. When Messrs. Ohm and Faraday discovered these properties long ago, they really had no concept of the way their components would be used today.

Typically, capacitors are measured in microfarads, and just as often, Pico farads (millionths and trillionths of a Farad respectively). Resistors of ten or one hundred Ohms are not that uncommon, but most of the ones in your PC or cell phones are measured in Kilohms (1000 Ohms).

Inductors

The complement to a capacitor is an inductor, which is merely a coil of wire, frequently wound on an iron core. DC has no trouble passing through an inductor since it is, after all, made of wire. But alternating currents have an increasingly difficult time, and as the frequency is raised less and less current will appear at the other end.

Inductors are measured in Henries, though again, most of the ones you're likely to encounter will be rated in milli henries or even micro henries. As more and more wire is added to the coil, the larger its value will be, and the less able high frequencies are to get through it. The amount of iron used for the core also has an effect, with more iron increasing the inductance.

In practice, inductors are not always used where they could be, since they may be simulated less expensively using other components. (A complex issue not worth getting into here.) Copper wire and iron are quite expensive these days, plus an inductor's bulk and weight don't lend themselves to today's miniaturized equipment.

However, the real point is that an inductor is also frequency sensitive, and it is exactly the opposite of a capacitor.

How to read Capacitor Codes?
Surplus capacitors

Large capacitor have the value printed plainly on them, such as 10.uF (Ten Micro Farads) but smaller disk types along with plastic film types often have just 2 or three numbers on them?
First, most will have three numbers, but sometimes there are just two numbers. These are read as Pico-Farads. An example: 47 printed on a small disk can be assumed to be 47 Pico-Farads (or 47 puff as some like to say)
Now, what about the three numbers? It is somewhat similar to the resistor code. The first two are the 1st and 2nd significant digits and the third is a multiplier code. Most of the time the last digit tells you how many zeros to write after the first two digits, but the standard (EIA standard RS-198) has a couple of curves that you probably will never see. But just to be complete here it is in a table.
What these numbers don't tell us is the ESR rating of a capacitor. Despite popular belief capacitors will often still have the correct value of capacitance when they fail. To truly check a capacitor's condition, you need a meter that measures the ESR.

By milli, micro, nano, pico,

1 mili Farad (or any other unit) is 1/1,000th or .001 times the unit. (10-3)
1 micro = 1/1,000,000 or 0.000 001 times the unit (10-6)
1 nano = 1/1,000,000,000 or 0.000 000 001 times the unit (10-9)
1 pico = 1/1,000,000,000,000 or 0.000 000 000 001 times the unit (10-12)

Table 1 Digit multipliers

Third digit	Multiplier (this times the first two digits gives you the value in Pico-Farads)
0	1
1	10
2	100
3	1,000
4	10,000

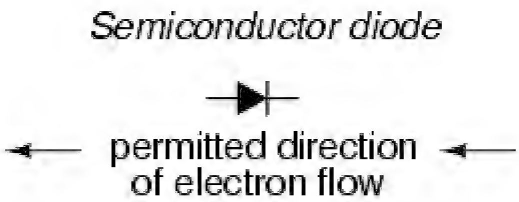
5	100,000
6 not used	
7 not used	
8	.01
9	.1

Now for an example: A capacitor marked 104 is 10 with 4 more zeros or 100,000pF which is otherwise referred to as a .1 uF capacitor. Most kit builders don't need to go further, but I know you want to learn more. Anyway, Just to confuse you some more there is sometimes a tolerance code given by a single letter. I don't know why there were picked in the order they are, except that it kind of follows the middle row of keys on a typewriter. So a 103J is a 10,000 pF with +/-5% tolerance

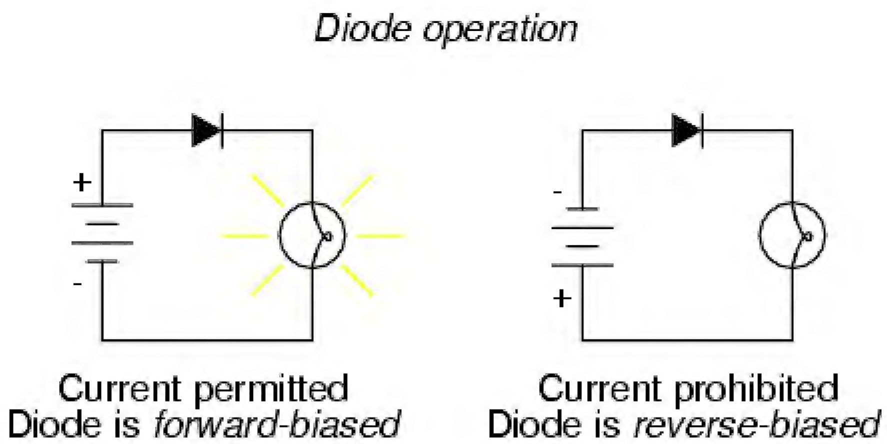
Diode

Introduction

A diode is an electrical device allowing current to move through it in one direction with far greater ease than in the other. The most common type of diode in modern circuit design is the semiconductor diode, although other diode technologies exist. Semiconductor diodes are symbolized in schematic diagrams as such:



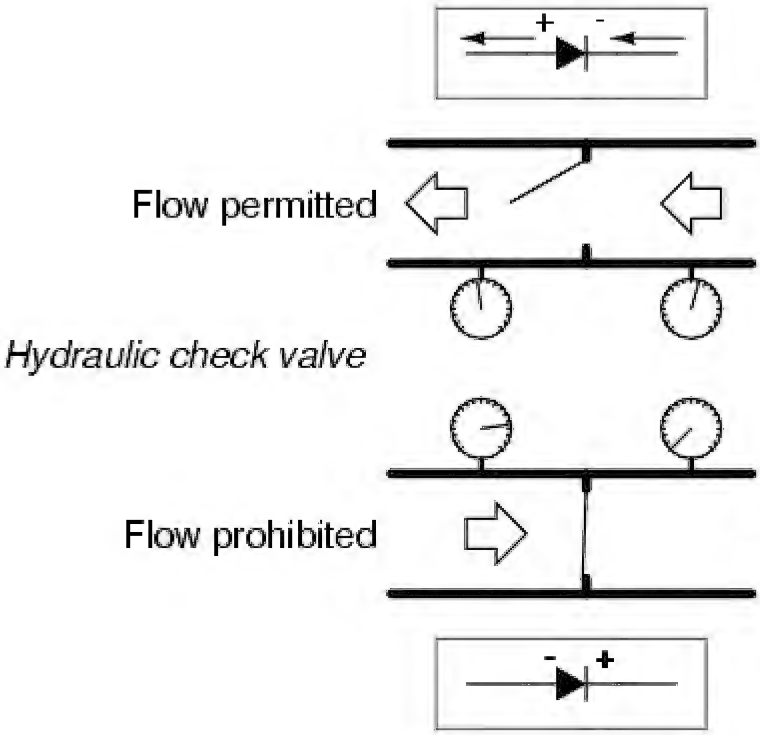
When placed in a simple battery-lamp circuit, the diode will either allow or prevent current through the lamp, depending on the polarity of the applied voltage:



When the polarity of the battery is such that electrons are allowed to flow through the diode, the diode is said to be forward-biased. Conversely, when the battery is "backward" and the diode blocks current, the diode is said to be reverse-biased. A diode may be thought of as a kind of switch: "closed" when forward-biased and "open" when reverse-biased.

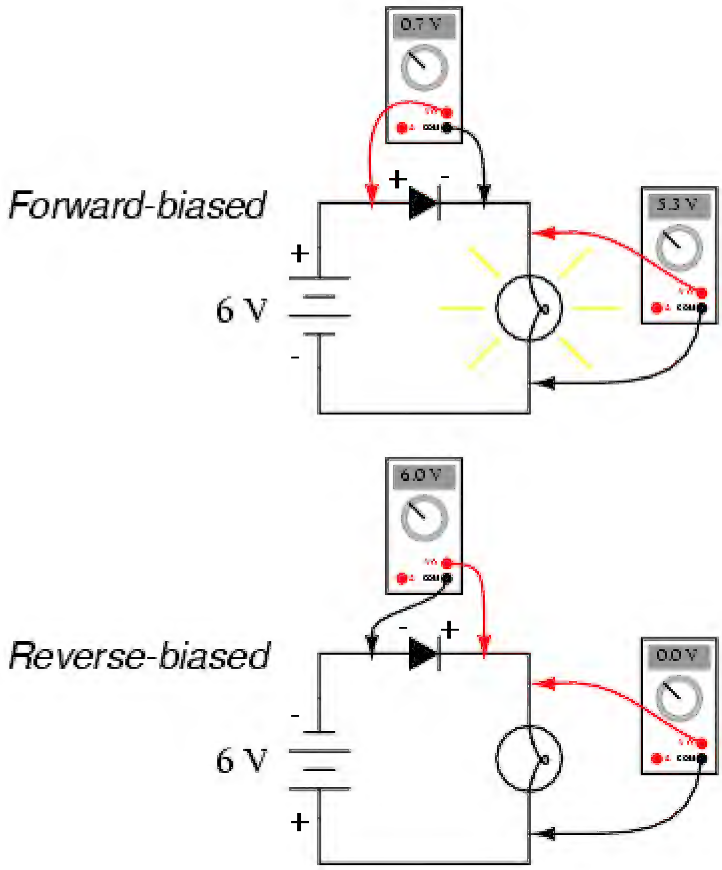
Oddly enough, the direction of the diode symbol's "arrowhead" points against the direction of electron flow. This is because the diode symbol was invented by engineers, who predominantly use conventional flow notation in their schematics, showing current as a flow of charge from the positive (+) side of the voltage source to the negative (-). This convention holds true for all semiconductor symbols possessing "arrowheads:" the arrow points in the permitted direction of conventional flow, and against the permitted direction of electron flow.

Diode behavior is analogous to the behavior of a hydraulic device called a check valve. A check valve allows fluid flow through it in one direction only:



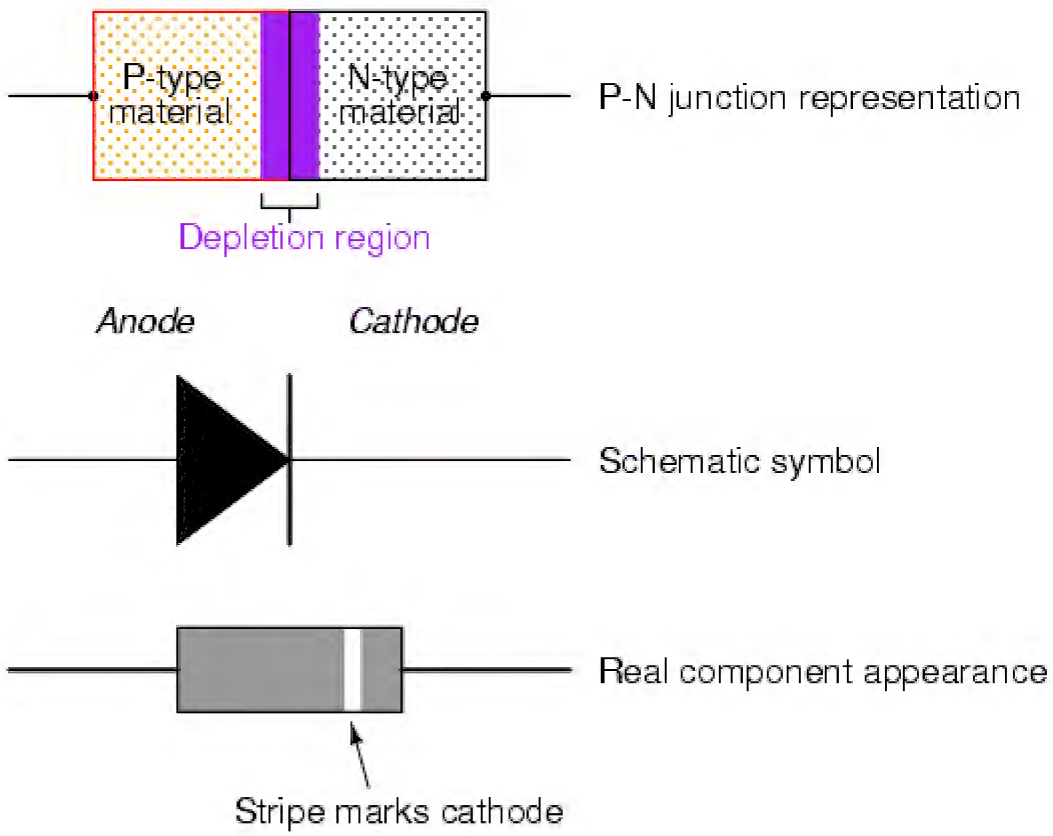
Check valves are essentially pressure-operated devices: they open and allow flow if the pressure across them is of the correct "polarity" to open the gate (in the analogy shown, greater fluid pressure on the right than on the left). If the pressure is of the opposite "polarity," the pressure difference across the check valve will close and hold the gate so that no flow occurs.

Like check valves, diodes are essentially "pressure-" operated (voltage-operated) devices. The essential difference between forward-bias and reverse-bias is the polarity of the voltage dropped across the diode. Let's take a closer look at the simple battery-diode-lamp circuit shown earlier, this time investigating voltage drops across the various components:

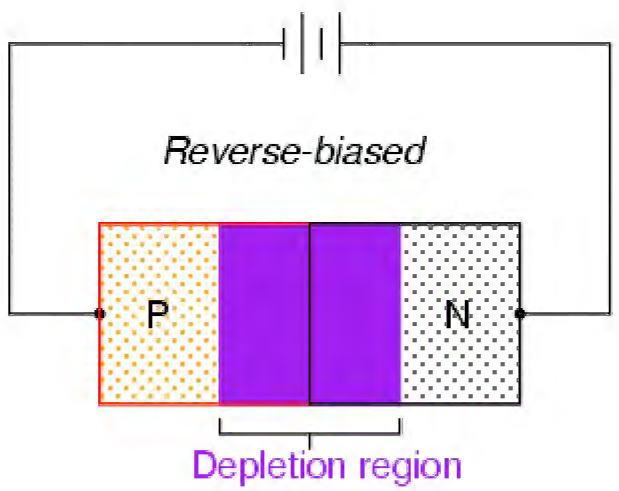


When the diode is forward-biased and conducting current, there is a small voltage dropped across it, leaving most of the battery voltage dropped across the lamp. When the battery's polarity is reversed and the diode becomes reverse-biased, it drops all of the battery's voltage and leaves none for the lamp. If we consider the diode to be a sort of self-actuating switch (closed in the forward-bias mode and open in the reverse-bias mode), this behavior makes sense. The most substantial difference here is that the diode drops a lot more voltage when conducting than the average mechanical switch (0.7 volts versus tens of millivolts).

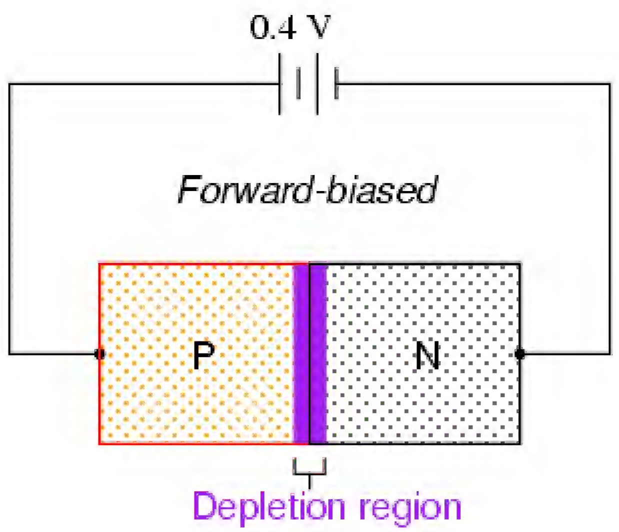
This forward-bias voltage drop exhibited by the diode is due to the action of the depletion region formed by the P-N junction under the influence of an applied voltage. When there is no voltage applied across a semiconductor diode, a thin depletion region exists around the region of the P-N junction, preventing current through it. The depletion region is for the most part devoid of available charge carriers and so acts as an insulator:

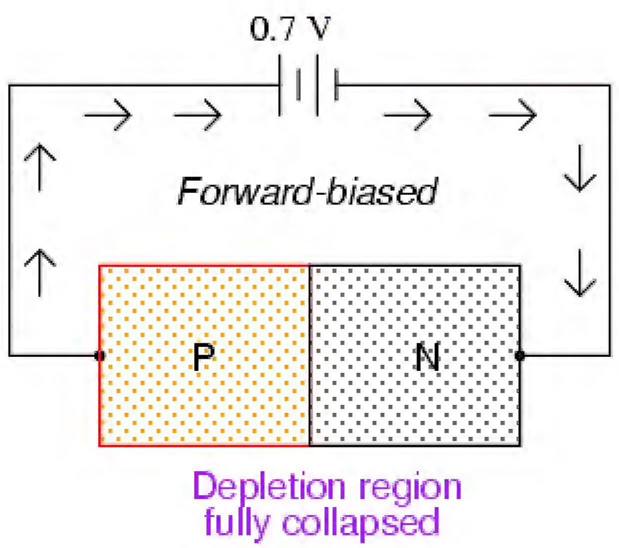


If a reverse-biasing voltage is applied across the P-N junction, this depletion region expands, further resisting any current through it:



Conversely, if a forward-biasing voltage is applied across the P-N junction, the depletion region will collapse and become thinner, so that the diode becomes less resistive to current through it. In order for a sustained current to go through the diode, though, the depletion region must be fully collapsed by the applied voltage. This takes a certain minimum voltage to accomplish, called the forward voltage:



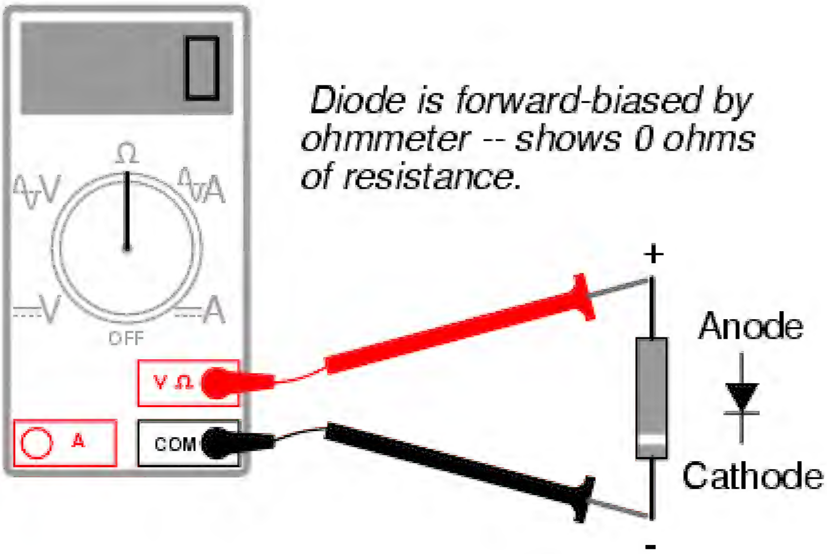


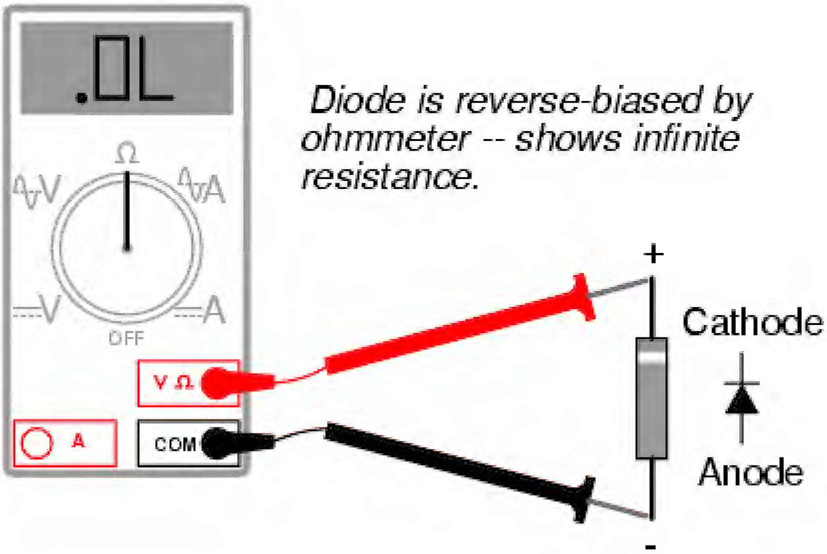
For silicon diodes, the typical forward voltage is 0.7 volts, nominal. For germanium diodes, the forward voltage is only 0.3 volts. The chemical constituency of the P-N junction comprising the diode accounts for its nominal forward voltage figure, which is why silicon and germanium diodes have such different forward voltages. Forward voltage drop remains approximately equal for a wide range of diode currents, meaning that diode voltage drop not like that of a resistor or even a normal (closed) switch. For most purposes of circuit analysis, it may be assumed that the voltage drop across a conducting diode remains constant at the nominal figure and is not related to the amount of current going through it.

In actuality, things are more complex than this. There is an equation describing the exact current through a diode, given the voltage dropped across the junction, the temperature of the junction, and several physical constants. It is commonly known as the diode equation:

Meter check of a diode

Being able to determine the polarity (cathode versus anode) and basic functionality of a diode is a very important skill for the electronics hobbyist or technician to have. Since we know that a diode is essentially nothing more than a one-way valve for electricity, it makes sense we should be able to verify its one-way nature using a DC (battery-powered) ohmmeter. Connected one way across the diode, the meter should show a very low resistance. Connected the other way across the diode, it should show a very high resistance ("OL" on some digital meter models):



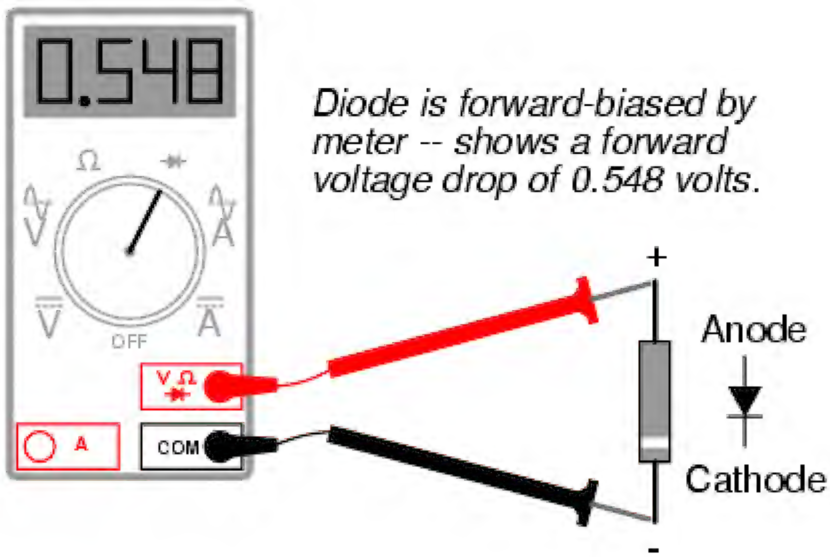


Of course, in order to determine which end of the diode is the cathode and which is the anode, you must know with certainty which test lead of the meter is positive (+) and which is negative (-) when set to the "resistance" or "Ω" function. With most digital multimeters I've seen, the red lead becomes positive and the black lead negative when set to measure resistance, in accordance with standard electronics color-code convention. However, this is not guaranteed for all meters. Many analog multimeters, for example, actually make their black leads positive (+) and their red

leads negative (-) when switched to the "resistance" function, because it is easier to manufacture it that way!

One problem with using an ohmmeter to check a diode is that the readings obtained only have qualitative value, not quantitative. In other words, an ohmmeter only tells you which way the diode conducts; the low-value resistance indication obtained while conducting is useless. If an ohmmeter shows a value of "1.73 ohms" while forward-biasing a diode, that figure of 1.73 Ω doesn't represent any real-world quantity useful to us as technicians or circuit designers. It neither represents the forward voltage drop nor any "bulk" resistance in the semiconductor material of the diode itself, but rather is a figure dependent upon both quantities and will vary substantially with the particular ohmmeter used to take the reading.

For this reason, some digital multimeter manufacturers equip their meters with a special "diode check" function which displays the actual forward voltage drop of the diode in volts, rather than a "resistance" figure in ohms. These meters work by forcing a small current through the diode and measuring the voltage dropped between the two tests leads:

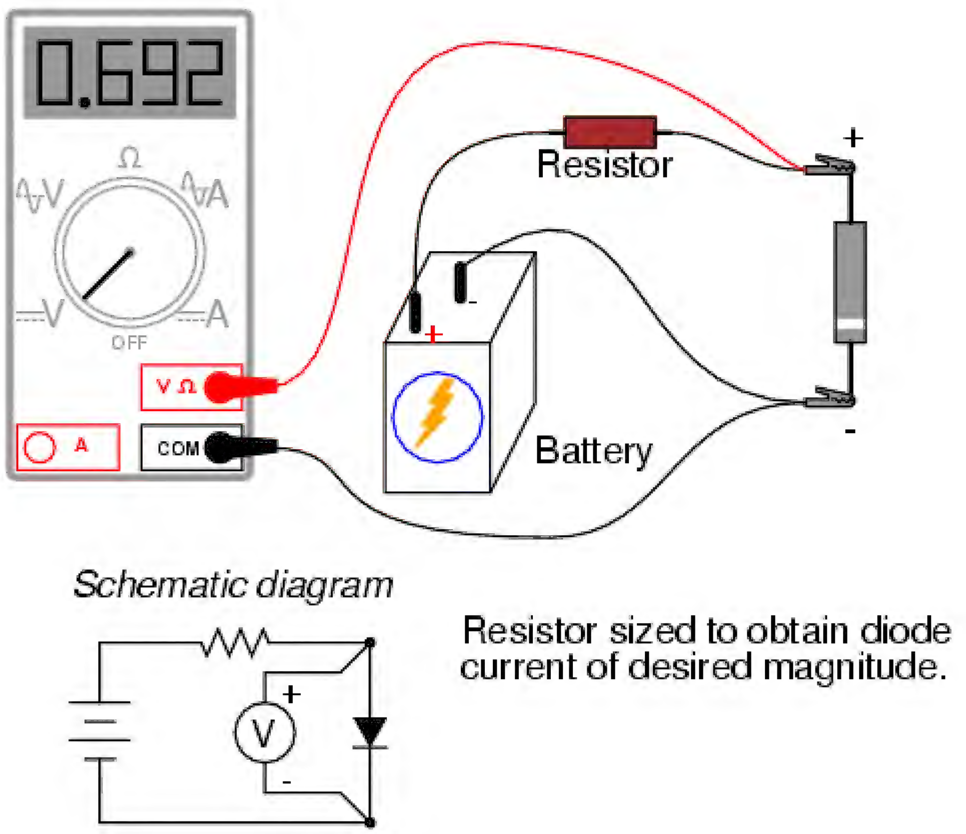


The forward voltage reading obtained with such a meter will typically be less than the "normal" drop of 0.7 volts for silicon and 0.3 volts for germanium, because the current provided by the meter is of trivial proportions. If a multimeter with diode-check function isn't available, or you would like to measure a diode's forward voltage drop at some non-trivial current, the following circuit may be constructed using nothing but a battery, resistor, and a normal voltmeter:

Connecting the diode backwards to this testing circuit will simply result in the voltmeter indicating the full voltage of the battery.

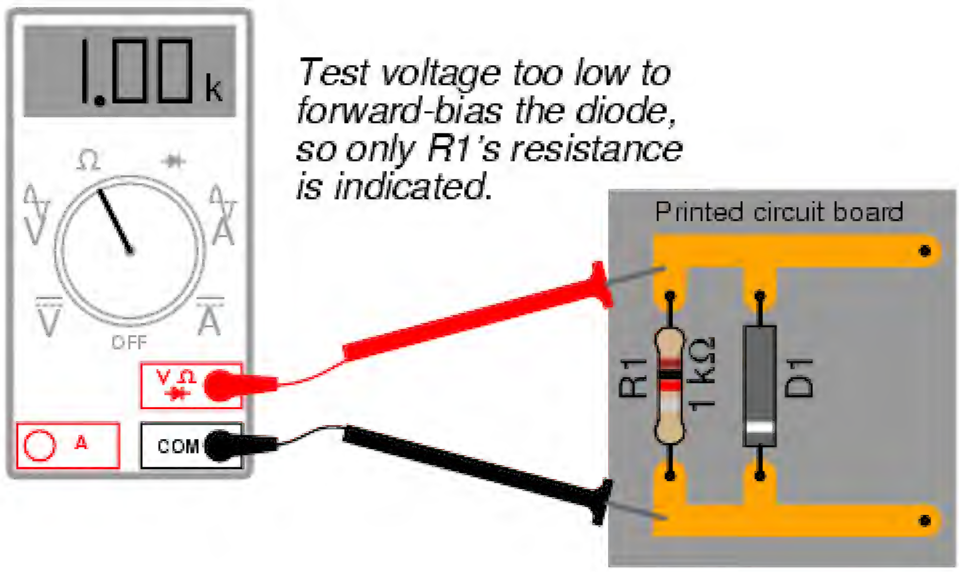
If this circuit were designed so as to provide a constant or nearly constant current through the diode despite changes in forward voltage drop, it could be used as the

basis of a temperature-measurement instrument, the voltage measured across the diode being inversely proportional to diode junction temperature. Of course, diode current should be kept to a minimum to avoid self-heating (the diode dissipating substantial amounts of heat energy), which would interfere with temperature measurement.
Beware that some digital multimeters equipped with a "diode check" function may output a very low test voltage (less than 0.3 volts) when set to the regular "resistance" (Ω) function: too low to fully collapse the depletion region of a PN junction. The philosophy here is that the "diode check" function is to be used for testing semiconductor devices and the "resistance" function for anything else. By using a very low test voltage to measure resistance, it is easier for a technician to measure the resistance of non-semiconductor components connected to semiconductor components, since the semiconductor component junctions will not become forward-biased with such low voltages.

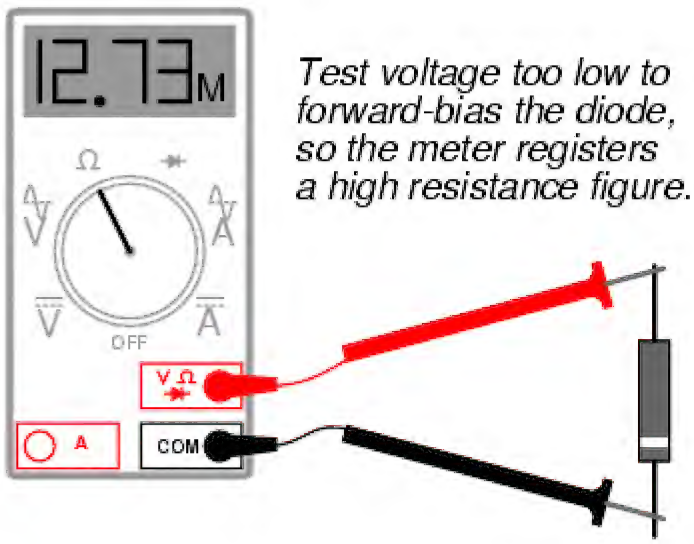


Consider the example of a resistor and diode connected in parallel, soldered in place on a printed circuit board (PCB). Normally, one would have to unsolder the resistor from the circuit (disconnect it from all other components) before being able to measure its resistance, otherwise any parallel-connected components would affect the

reading obtained. However, using a multimeter that outputs a very low test voltage to the probes in the "resistance" function mode, the diode's PN junction will not have enough voltage impressed across it to become forward-biased, and as such will pass negligible current. Consequently, the meter "sees" the diode as an open (no continuity), and only registers the resistor's resistance:



If such an ohmmeter were used to test a diode, it would indicate a very high resistance (many mega-ohms) even if connected to the diode in the "correct" (forward-biased) direction:



Reverse voltage strength of a diode is not as easily tested, because exceeding a normal diode's PIV usually results in destruction of the diode. There are special types of diodes, though, which are designed to "break down" in reverse-bias mode without damage (called Zener diodes), and they are best tested with the same type of voltage

source / resistor / voltmeter circuit, provided that the voltage source is of high enough value to force the diode into its breakdown region. More on this subject in a later section of this chapter.

Transformers

Speaking of blowing things up, I once had a crazy friend who owned a large variable power transformer. He would take an assortment of components and place them on a big flat rock in his back yard, where we could see them through the safety of his bedroom window. The components were then connected to the power transformer with a long heavy wire. Now this particular transformer could put out any voltage between zero and 240 volts, which was derived from being plugged into the wall outlet. Of course, the whole point was to start with a small amount of voltage, and then gradually increase it until the components blew up. I'll put it this way: a lot of juice was sent down that wire, and we had quite a bit of fun.

But what does that have to do with this tutorial? Nothing at all -- it's just a good story! Seriously, though, the purpose of a transformer is to convert voltages either up or down, but it only works with AC current. Though a transformer is more like an inductor than a capacitor, it uses magnetism to allow the electricity to pass between wires that aren't connected. Let's take a closer look.

Transformers use a principle known as magnetic induction, and they operate much like the transmission in an automobile. Unlike the permanent magnets that some people stick on their refrigerator, an electromagnet consists of a coil of wire wound around a piece of iron or steel. When an electric current is applied to the ends of the wire, the iron core becomes magnetized. And when the electricity is removed the magnetism disappears.

It should come as no surprise that the exact opposite holds true as well -- if you magnetize the iron, then electricity will be developed in the wire. In fact, this is how electric generators in a power plant work. But in order for a voltage to be produced, the magnetism must be constantly changing. That is, putting a coil of wire over a permanent magnet won't do a thing, except for the instant it's first put into place.

A transformer, therefore, requires AC to operate, and it is made up of two coils of wire wrapped around a single piece of iron. When a constantly alternating voltage is applied to one of the wires the iron will become magnetized, though the magnet's polarity (North/South) will also change constantly. And while one of the coils is creating the magnetism, the other will respond by generating electricity from it. But what does this have to do with an auto transmission?

In a transmission, gears are used to vary the speed of your car, though at the expense of apparent power. That is, for a given amount of horsepower, you can either go slowly but with the ability to climb a steep hill, or go much faster as long as you stick

to level terrain. Remember, the power doesn't really vary when you change gears, only the way that power is used. Nothing comes for free, and the transmission merely changes the way an engine's power is distributed.

In an identical manner, a transformer can transform a voltage that is applied to one of the wires, to produce a higher or lower voltage in the other. The key point here is the ratio between the numbers of windings in each coil. If one of the coils consists of 200 turns of wire, and the other has only 100, then the ratio between them will be two to one. And if you put ten volts into the larger coil, only five volts will appear in the smaller one, though the available current will be twice as much. The actual power always stays the same, and it's just the distribution that really changes.

By the way, even when a circuit could operate on 115 volts directly, a transformer is often used just for safety. The very fact that the two windings are not really connected provides some degree of protection against being electrocuted.

Semiconductors

One of the most significant developments of the twentieth century is undoubtedly the semiconductor. These devices are nothing short of miraculous, and without them there would be no satellite TV, and no PCs. Most semiconductor devices these days are made of silicon material, though you might occasionally find a diode or transistor made from germanium. But what are they really, and how do they work?

The simplest semiconductor of all is the diode, and it allows electricity to flow in only one direction. One obvious use might be to protect a portable radio if you accidentally install the battery backwards. Since a diode lets current travel in only one direction the radio would simply not operate, as opposed to being damaged. But a diode has many other important uses as well, and is the basis for a number of applications where AC must be converted to DC.

Fuse

A device used to protect devices from excessive electrical current. It contains a conductor that melts and breaks the current flow when too much electricity flows through it. Once a fuse is blown it must be replaced with another one to close the circuit and allow electricity to flow again.

Power Supplies

When workings with electronics, you always need one basic thing; power. A part that converts the power from a wall outlet into the lower voltages, typically 5 to 12 volts

DC, required internally in the computer. PC power supplies are usually rated in watts, ranging from 90 watts at the low end to 300 watts at the high end. If the power supply in your computer fails, nothing works, not even the fan.
All electronic circuits require some source of power in order to operate. For a digital watch or cell phone, that power comes from a battery. But for devices that connect to a wall outlet, some means of converting the 220 volts down to a level that the device can actually use must be provided. A power supply is the obvious solution, and it does a variety of other things in the process.
Though a transformer can adjust the voltage, most circuits will operate on DC only. So another conversion must also be performed. This is where the diode comes in, though in most power supplies at least two diodes are used. If only one diode is placed into an AC circuit, then only half of the available electricity will be used. Remember, half the time the electricity is going in one direction, and the other half it is reversed. So if a single diode is used the current passes only when the AC happens to be going in the favored direction, wasting the other half of the current flow.
There are many ways to construct a power supply, some using one diode, some using two, and others using four or more. It is not favoured to see a lot of value in belaboring all the possibilities, and hope you'll understand if we move along to other, more important aspects of power supplies. For example, regulation and filtering.
Once an AC voltage has been converted to its DC counterpart, the job is still not quite complete. Unless additional steps are taken, the voltage will still fluctuate. Even though the direction is no longer changing. The original AC voltage is constantly varying in level gradually reaching a maximum, and then progressing towards zero, and again approaching a maximum in the other direction. Therefore, even though the diode can block the voltage when it goes the wrong way, the level is still changing.
As mentioned earlier that besides its frequency capabilities a capacitor can also be used to store electricity, earlier much like a rechargeable battery. It is precisely this property that will help us out here. How much current can be stored, and for how long, depends on the size of the capacitor. But once an adequate value has been chosen, this capacitor will continue to supply voltage when the incoming level drops below its maximum. A power supply that uses capacitors this way is said to be filtered, though the purity of the DC that results depends on several factors.
The most important consideration is how much current is being drawn by the powered device. That is, if the capacitor needs to provide only a small amount of current, then it won't be depleted very much between cycles. Similarly, when a higher frequency of AC input voltage is used, the capacitor won't have to provide the current for as long. But no matter how large the capacitor is, some amount of fluctuation will still occur. For circuits such as a PC that require a very stable voltage, the only real solution is to employ regulation.

Voltage Regulator

A voltage regulator is a fairly simple circuit, though again, I won’t go into great detail since it's just the principles that matter here. However, the general idea of a regulated supply is that it's capable of putting out slightly more power than is actually required, and uses some type of sensing circuit to constantly monitor its own output. When the powered circuit demands more juice, the sensor adjusts a built-in electronic valve to turn it up. Likewise, if the AC input varies -- for example your air conditioner just kicked in -- that can be compensated for as well.

So far we've assumed that a power transformer will be used to drop the original 115 volts down to something more manageable for the rest of the supply. But there's a problem with most transformers: they're big and heavy. Worse, the lower the frequency to be transformed, the more iron that is needed for the transformer to work efficiently. This is where switching supplies come in, and at last we're getting to something digital!

Since a computer's size and weight are sometimes as important as its speed, savvy designers will do everything possible to keep those to a minimum. Further, since electronic components are less expensive than copper and iron, a power supply that is twice as complex may still be cheaper to build if it can use a smaller transformer. With that in mind, let's look at how a switching power supply operates.

Most switching supplies begin with an extremely crude normal power supply. No regulation, minimal filtering, not evens a transformer -- it plugs right into the wall! Then, a circuit called an oscillator is connected to this "cheap" supply to create a new AC voltage, though at a much higher frequency. (The oscillators you may have encountered probably had a big dial, and produced a sweeping audio tone. The same idea applies here too, although the frequency is not adjustable.)

In this case the oscillator is used to rapidly switch the crude supply on and off, thereby simulating an AC voltage. But the whole point is that since the AC is artificially created, we can make it any frequency we'd like. And if we choose a high enough frequency, only a very small amount of iron is needed in the transformer that is ultimately required.

Another important reason many PC designers favor a switching power supply is because it also provides an improved means of regulation. As we saw earlier, all power supplies have the capability to put out slightly more power than is actually needed, with the slack being discarded by the circuits that sense the output voltage. However, an unfortunate side effect of throwing away the extra current is that it is always dissipated as heat, which also wastes power. But a switching supply can do this more intelligently, by varying the duty cycle of the AC voltage it creates.

Since creating AC from DC in a switching supply is simply a matter of turning the original power rapidly on and off, the relative times may be easily varied. That is, if

the output voltage is sensed as being too high, then the "off" time can be made slightly longer. And when it falls too low, the "on" time is adjusted instead. The duty cycle of a power supply is always expressed as a percentage, with 50% meaning on for exactly half the time.

Transistors

Transistors are made of the same silicon material that is used to create diodes; however they are slightly more complex internally. Most transistors are constructed in layers, with a piece of "P" material sandwiched between two other pieces of "N" material. (P and N refer to Positive and Negative.) The polarity of the silicon material is determined when it is manufactured, and this is something you'll just have to take for granted right now. By the way, some transistors are made in the reverse -- two pieces of P surrounding a single N. But that's really not important. What are important, however, are the properties these materials possess.

Earlier in this discussion we used analogies to show how the flow of electricity is very much like the flow of water. And that's true. Though it was alluded to then, we didn't quite get around to comparing a water faucet with its electronic counterpart, which is a transistor. In fact, the British still refer to a vacuum tube -- the transistor's predecessor -- as a valve. Just as a 98 pound weakling can control hundreds of pounds of water pressure by merely turning a valve (well okay, a big valve), a transistor can likewise be coaxed into controlling a large amount of current by applying a smaller one to it.

“Most transistors have three connecting wires, and the current to be controlled is attached to two of them. The third wire is used for a control voltage, and it can regulate the amount of electricity that flows between the other two. This is a very powerful concept, since a small amount of current can be used to control a much larger one, which results in amplification. By the way, the ratio of the amount of controlling current that is required versus the amount being controlled is called a transistor's gain.”

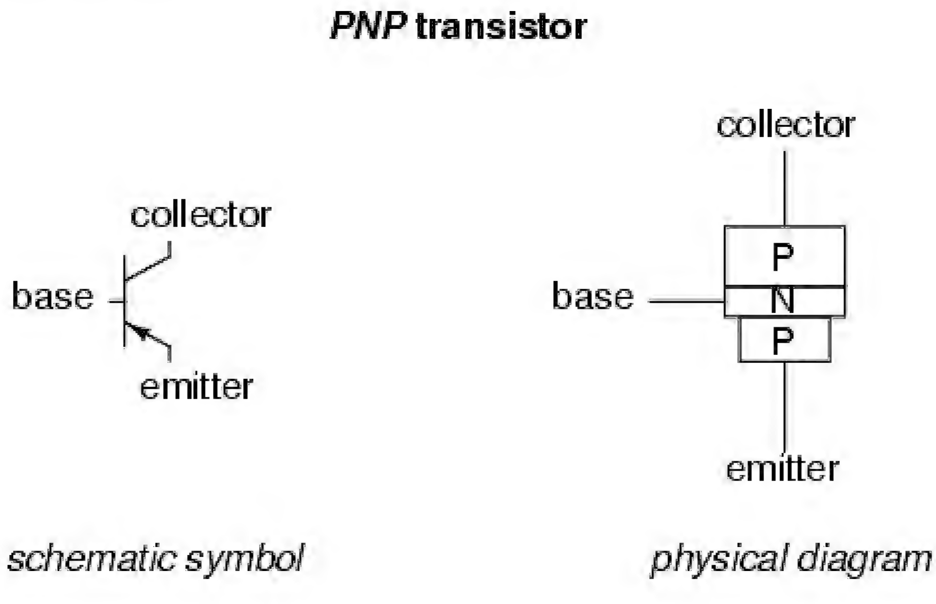
Armed with all of this knowledge, it's not very hard to see how a stereo phonograph works. A playback needle is attached to a tiny magnet, which is placed near a coil of wire that creates a voltage when the magnet moves. The coil is then attached to a transistor that controls the power from the power supply, which is connected to a speaker. And the knee bone's connected to the thigh bone, and the...

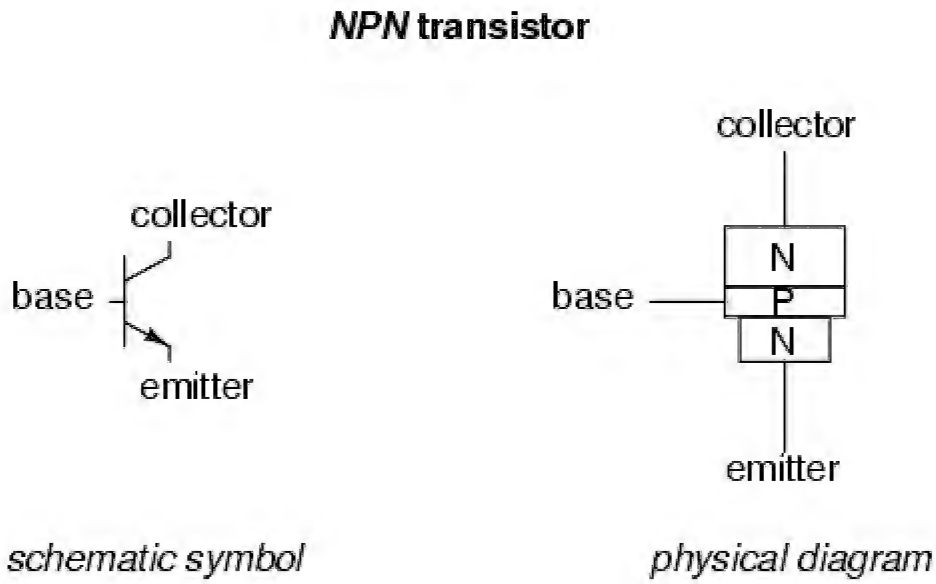
The more the phonograph needle wiggles, the more the loudspeaker at the end of the chain moves. And the faster the needle travels, then the faster the speaker moves. Simple, right? Right!

The invention of the bipolar transistor in 1948 ushered in a revolution in electronics. Technical feats previously requiring relatively large, mechanically fragile, power-hungry vacuum tubes were suddenly achievable with tiny, mechanically rugged, power-thrifty specks of crystalline silicon. This revolution made possible the design and manufacture of lightweight, inexpensive electronic devices that we now take for granted. Understanding how transistors function is of paramount importance to anyone interested in understanding modern electronics.

My intent here is to focus as exclusively as possible on the practical function and application of bipolar transistors, rather than to explore the quantum world of semiconductor theory. Discussions of holes and electrons are better left to another chapter in my opinion. Here I want to explore how to use these components, not analyze their intimate internal details. I don't mean to downplay the importance of understanding semiconductor physics, but sometimes an intense focus on solid-state physics detracts from understanding these devices' functions on a component level. In taking this approach, however, I assume that the reader possesses a certain minimum knowledge of semiconductors: the difference between "P" and "N" doped semiconductors, the functional characteristics of a PN (diode) junction, and the meanings of the terms "reverse biased" and "forward biased." If these concepts are unclear to you, it is best to refer to earlier chapters in this book before proceeding with this one.

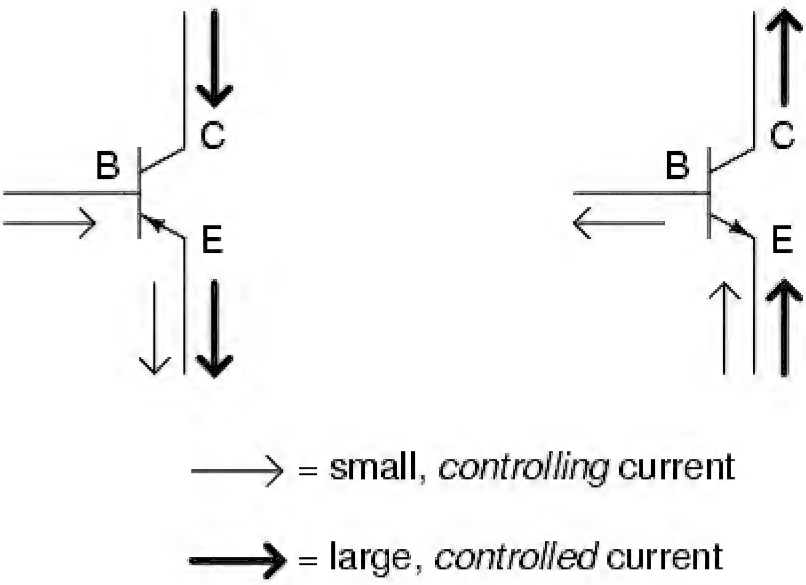
A bipolar transistor consists of a three-layer "sandwich" of doped (extrinsic) semiconductor materials, either P-N-P or N-P-N. Each layer forming the transistor has a specific name, and each layer is provided with a wire contact for connection to a circuit. Shown here are schematic symbols and physical diagrams of these two transistor types:





The only functional difference between a PNP transistor and an NPN transistor is the proper biasing (polarity) of the junctions when operating. For any given state of operation, the current directions and voltage polarities for each type of transistor are exactly opposite each other.

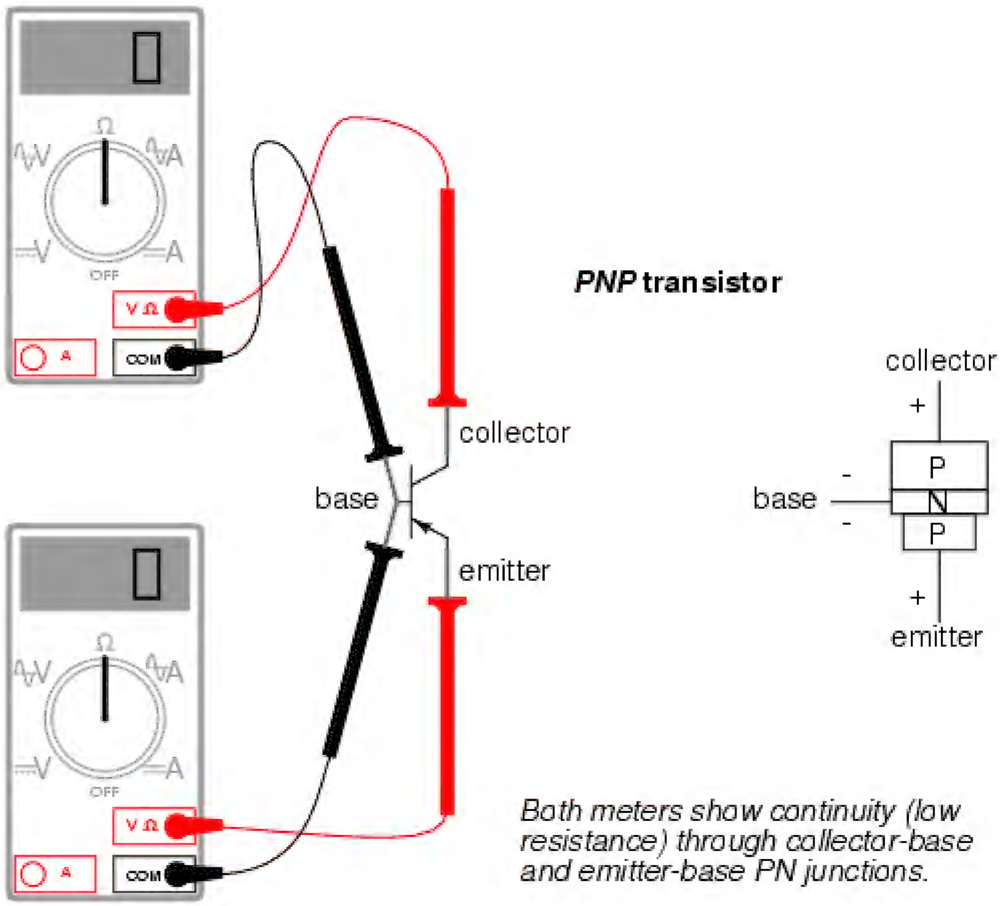
Bipolar transistors work as current-controlled current regulators. In other words, they restrict the amount of current that can go through them according to a smaller, controlling current. The main current that is controlled goes from collector to emitter, or from emitter to collector, depending on the type of transistor it is (PNP or NPN, respectively). The small current that controls the main current goes from base to emitter, or from emitter to base, once again depending on the type of transistor it is (PNP or NPN, respectively). According to the confusing standards of semiconductor symbology, the arrow always points against the direction of electron flow:



Bipolar transistors are called bipolar because the main flow of electrons through them takes place in two types of semiconductor material: P and N, as the main current goes from emitter to collector (or visa-versa). In other words, two types of charge carriers -- electrons and holes -- comprise this main current through the transistor.
As you can see, the controlling current and the controlled current always mesh together through the emitter wire, and their electrons always flow against the direction of the transistor's arrow. This is the first and foremost rule in the use of transistors: all currents must be going in the proper directions for the device to work as a current regulator. The small, controlling current is usually referred to simply as the base current because it is the only current that goes through the base wire of the transistor. Conversely, the large, controlled current is referred to as the collector current because it is the only current that goes through the collector wire. The emitter current is the sum of the base and collector currents, in compliance with Kirchhoff's Current Law.
If there is no current through the base of the transistor, it shuts off like an open switch and prevents current through the collector. If there is a base current, then the transistor turns on like a closed switch and allows a proportional amount of current through the collector. Collector current is primarily limited by the base current, regardless of the amount of voltage available to push it. The next section will explore in more detail the use of bipolar transistors as switching elements.

Meter check of a transistor

Bipolar transistors are constructed of a three-layer semiconductor "sandwich," either PNP or NPN. As such, they register as two diodes connected back-to-back when tested with a multimeter's "resistance" or "diode check" functions:



Here I'm assuming the use of a multimeter with only a single continuity range (resistance) function to check the PN junctions. Some multimeters are equipped with two separate continuity check functions: resistance and "diode check," each with its own purpose.

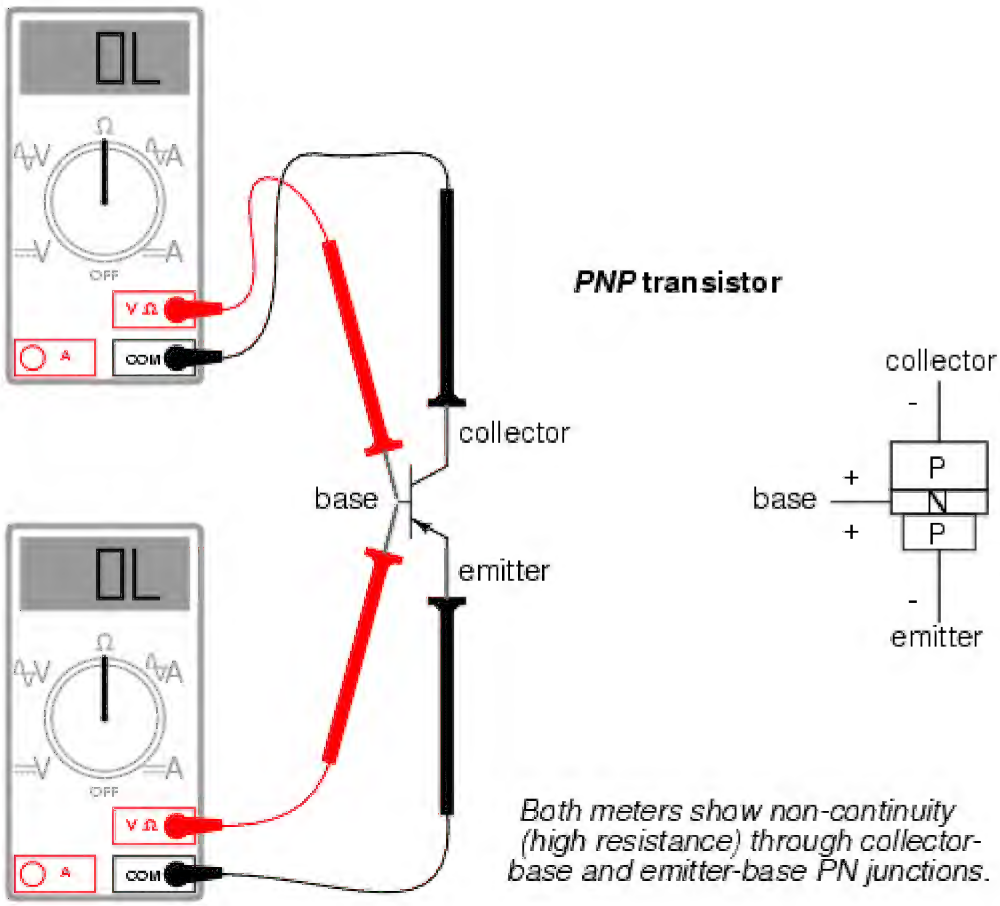
If your meter has a designated "diode check" function, use that rather than the "resistance" range, and the meter will display the actual forward voltage of the PN junction and not just whether or not it conducts current.

Meter readings will be exactly opposite, of course, for an NPN transistor, with both PN junctions facing the other way. If a multimeter with a "diode check" function is used in this test, it will be found that the emitter-base junction possesses a slightly greater forward voltage drop than the collector-base junction. This forward voltage difference is due to the disparity in doping concentration between the emitter and collector regions of the transistor: the emitter is a much more heavily doped piece of semiconductor material than the collector, causing its junction with the base to produce a higher forward voltage drop.

Knowing this, it becomes possible to determine which wire is which on an unmarked transistor. This is important because transistor packaging, unfortunately, is not standardized. All bipolar transistors have three wires, of course, but the positions of

the three wires on the actual physical package are not arranged in any universal, standardized order.

Suppose a technician finds a bipolar transistor and proceeds to measure continuity with a multimeter set in the "diode check" mode. Measuring between pairs of wires and recording the values displayed by the meter, the technician obtains the following data:



Feedback

There's only one more thing to consider about the transistor, and that is the fact that its amplification of currents is less than ideal. Oh, you can be sure that as more and more current is applied to it, more and more will appear at the other end. But along the way, a nasty side-effect crop up, which is nonlinearity. This four-bit word actually describes a fairly simple problem, whereby the ratio between the controlling input and the output doesn't always stay fixed. When a small amount of voltage is put into a

transistor, it will have more gain than for a larger voltage. With an audio amplifier, nonlinearity in the circuit creates distortion.

The underlying reason for this is quite complex, however the solution is very simple: negative feedback. Some examples of negative feedback in the home can be found inside a toilet tank, as well as in your oven. Suppose you're about to cook a frozen dinner. You'd go to the oven and set the thermostat for, say, 400 degrees. The heating coils begin to glow and remain on until the correct temperature is reached, at which point they will turn off. After a few minutes, as the oven begins to cool, the coils are again activated thus maintaining a constant temperature.

Earlier we saw how a power supply is designed to sense its own output, so as to regulate the voltage that's produced. And as a circuit drew more and more current (or if the air conditioner came on lowering the AC input voltage) the supply could then adjust itself to produce more output. The same thing happens with an oven, only in this case the thermostat does the sensing, and it controls the heating coils.

More sophisticated ovens use a proportional controller rather than simply turning the coils on and off. As the temperature drops, the voltage is increased; once it approaches the right amount, the voltage is decreased. But the whole point of all this is that it is possible for a circuit to control itself, by merely sampling some of its own output. The power supply needs to do this because the line voltage may drop, or the circuit being powered may demand more current. A transistor amplifier uses negative feedback to overcome its own inherent nonlinearity, though the principle is identical.

Analog & Digital concepts

Most electronics enthusiasts generally fall into one of two camps: digital or analog. As you must already know, digital circuits are comprised of voltages that are either on or off, which in computerize is referred to as One and Zero. A good example here would be your emergency flashlight -- it's either turned on or it isn't.

Analog circuits, on the other hand, can contain a range of possible values, for example the voltages traveling through an audio amplifier that powers a loudspeaker. On soft passages of music, the voltage produced is very small and the speaker moves back and forth only slightly. But when the music becomes louder, the voltage and movement will be that much greater. With audio, though, how quickly the speaker moves is also a factor.

Digital logic circuits

All right, we've looked at analog electronics enough. While those are all important and useful topics, we should now move along and get down to some digital basics. Well also look at schematic diagrams, the blueprints of electronic circuits.
Everyone knows that the real brains in a PC are its CPU, but what many don't understand is exactly how it works. While this tutorial can't replace a college level course, I will cover the important fundamentals. As usual, we'll start at the very beginning, which in this case are logic gates.

Relays

Early digital logic circuits employed relays to perform all of the required functions. A relay is constructed from three very basic components: an electromagnet, a switch, and a spring. But where most switches are activated by pushing a button or throwing a lever, the switch (or switches) in a relay change state when voltage is applied to the coil of the electromagnet. The voltage causes the iron core to become magnetized, which then pulls the metal switch contacts into position. And when the voltage is removed, the spring takes over and pulls the contacts back. Most relays contain at least two switches, though some have as many as four or more, offering a wide range of possible circuit combinations.
Since drawing a realistic picture of an electronic component is not always the most efficient way to convey a circuit, electronic engineers instead use a schematic diagram. Most schematic representations are really pretty close to what an equivalent picture might look like, and a relay is shown both ways for you to compare.
Figure 1 shows the schematic for a single-pole (one switch) double-throw relay. The term double-throw means that one element -- called the common -- will be connected to either of two possible contacts: normally open, or normally closed. That is, when the relay is at rest with no voltage applied to its coil, the common contact is connected to the normally closed contact. And when the relay is activated, the common will be connected to the normally open one instead.
One of the basic logic functions that a relay can perform is called a latch, which is shown in Figure 2. A latch is used to allow a "push to start" type of operation, for example in most microwave ovens. Without it, you'd have to stand there and hold the button for the entire time it's cooking. Sure, you could use a regular toggle switch instead, but then how would the oven be able to turn itself off after five minutes?
Here, a double-pole double-throw relay is needed, since one of the switches is required just to perform the latching function, and the other (not shown) can then do

whatever you want. When the pushbutton switch is pressed the coil is energized by the power supply, causing both switches to change state.
Notice, however, that the lower set of contacts is connected in parallel with the pushbutton switch, thereby maintaining power to the coil after the button is released. The relay will stay in this activated state so long as the power source is not interrupted. Incidentally, you could consider this latching action to be a form of positive feedback, since the output is being used to reinforce the input.
Negative feedback can also be applied to a relay's operation, as shown in Figure 3. This oscillator circuit -- commonly known as a buzzer -- is created by wiring the switch contacts in series with the coil. When power is applied the coil will be energized, which causes the switch to change. Of course, the moment this happens power to the coil is interrupted, and the spring pulls the switch contacts back to a normal state. But this activates the coil all over again, and the process continues to repeat indefinitely. I realize this is pretty basic stuff, but then so are most logic circuits.

Counters

Solid state counters have a variety of applications in the real world, for example the electronic stop watches used at a sporting event. Figure 10 shows a binary counter, again as a standard logic diagram. Even though this particular device can count only to 16, it is not hard to see how the principle can be extended to allow counting to any reasonable number.
By the way, digital logic circuits are not specified in the same way as resistors and capacitors, since they don't have an actual "value." They are instead assigned part numbers by their manufacturer, and this particular counter is called a 7493. Here's how it works.
Besides the mandatory connections to the power supply, the 7493 also has two inputs and four outputs. One of the inputs is used simply to reset the count (all outputs zero), and the other is used as a "clock" to increment the count. That is, each time the clock input wire receives a momentary signal, the various outputs change.
The first time a clock pulse is received at the input, output number 1 will go high. The next clock causes output number 2 to go high, though at the same time output number 1 goes low. Remember, this is a binary counter, and each output wire represents a single bit of a complete number. The next clock that comes along will cause output number 1 to go high again, and the next one sets output 3, while clearing outputs 1 and 2. This continues until all of the outputs are set to one, though at the next occurrence of a clock input the count "wraps" around to begin all over again at zero.

As I mentioned before, all logic devices such as this counter are ultimately built from nothing more than gates. Though we don't really need to cover every logic device in such detail, other IC chips are available for performing a variety of different functions. Some of these are frequency dividers, whose output changes state for every other input clock signal, and shift registers that can pass a single bit through a long series of sequential stages.

For the 7493 in Figure 10, a separate output wire is used for each of the bits being counted. This type of set-up is called parallel, since all of the outputs are available simultaneously. Other devices are designed to operate in a serial fashion, where a single wire is used to sequentially carry a series of ones and zeroes. Can you see a similarity to the parallel and serial ports on a personal computer?

Because a serial system uses a single pair of wires, it is course much slower than an equivalent parallel system, where all of the bits are sent at one time. This doesn't really matter with printers, though, because they're so much slower than a PC to begin with. And with a modem we don't have a choice, because the signals must travel down the phone line which has only two wires. But disk controllers, memory chips, and most of the other circuits in your PC always use a parallel system, often called a bus, to carry the various signal around.

Another important consideration when dealing with solid state IC logic chips is their propagation delay. This term refers to how long it takes for the proper outputs to appear, once the inputs have been set. Or to put it another way, how long it takes the electricity to travel through it. Usually, propagation time is measured in nanoseconds, which of course is very short. But when you're trying to get a computer to run at 500 MHz. every nanosecond counts.

The RAM chips used for a PC's memory also have some minimum response time. When the CPU requests a byte of information from memory, a slight delay before the chips can respond is inevitable. So when an IC chip is rated at 50 nanoseconds (or whatever), what is really being described is how long it takes to respond.

Without wanting to get too far off the beaten path, it may be worth mentioning the cause for these inevitable delays, which is stray capacitance and inductance. Just as a capacitor is created by placing two pieces of metal in close proximity, some small amount of capacitance also results even when the pieces are farther apart. And the same phenomenon applies to inductance, too. Where most inductors are created by placing a length of wire into a coil, a straight piece used just for the various interconnections exhibits some inductance as well. Therefore, all of the wires and circuits in a PC and its chips have tiny amounts of inductance and capacitance, and the resultant frequency characteristics tend to slow things down.

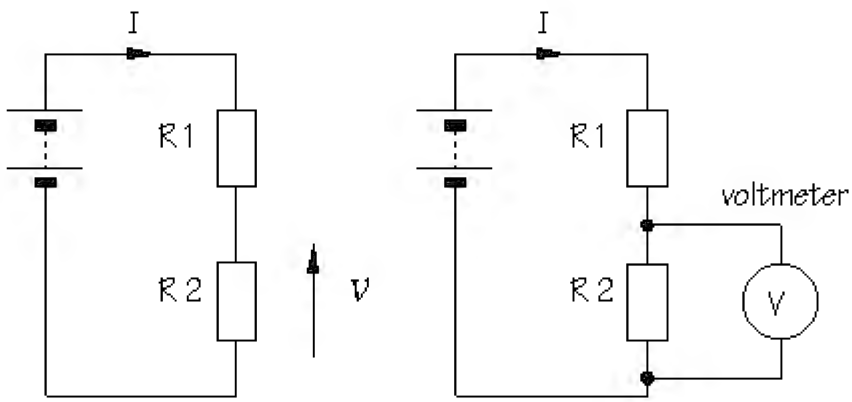
By the way, when we talk about the speed of a computer as being a number of Megahertz, what is really being considered is its clock frequency? A 300 Megahertz clock speed means that a new signal is being generated 300 million times per second.

Just like the 7493 counter chip that is incremented by one with each clock pulse that's applied, computers work the same way. That is, all of a CPU's internal operations happen in step with its built in clock.
The next important area of digital circuit design is the central processor itself, which is considerably beyond what we can discuss here. All IC and component manufacturers provide literature about their products, but some go far beyond that giving complete working example circuits. While most of the catalogs are of course targeted at professional engineers, the books put out by National Semiconductor are outstanding in both content and clarity. In fact, their Linear Applications Handbook has a complete course describing how color TV works, besides many other tutorials and build-it projects.

Measuring Tools/Equipments

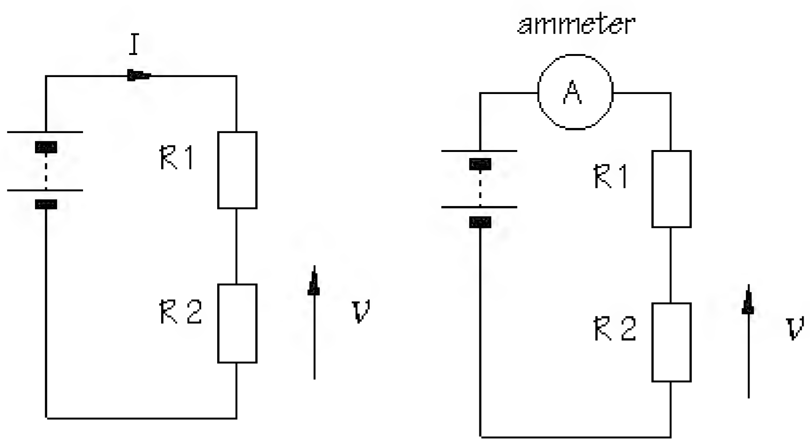
Voltmeters

Voltmeters should have a high value of resistance, but this is not always the case. Some **moving coil meters** (the kind with a needle and a scale) have quite a low resistance, about 10 000 Ω
This can lead to serious reading errors when we measure high resistance circuits.
Digital voltmeters have a very high resistance, about 107 (10 000 000 . or 10 Me ohms), which makes them almost perfect.
Diagram shows the circuit before and after connecting a voltmeter:



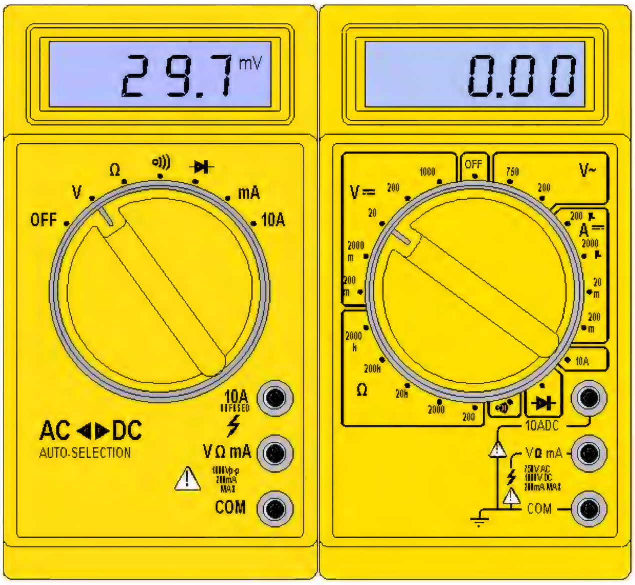
Ammeters

Ammeters have a very low value, but quite definite resistance.
The meter has a very low value resistor called a shunt wired in parallel.
Diagrams a circuit before and after connecting an ammeter:



Multimeters

The Multimeter is a combined instrument that can:
Measure voltage
Measure current
Measure resistance
Measure frequency in some instruments.



1-Function/Range Switch: selects the function (voltmeter, ammeter, or Ohmmeter) and the range for the measurement.

2-COM Input Terminal: Common ground, used in ALL measurements.
3-V Input Terminal: for voltage or resistance measurements.
4-200 mA Input Terminal: for small current measurements.
5-10 A Input Terminals: for large current measurements.
6-Low Battery LCD: appears when the battery needs replacement.

There may be an internal fuse or a cut out to prevent excessive currents in ammeter mode, which otherwise might damage the instrument. The digital multimeter is very close to being a perfect voltmeter, with a very high input resistance, with a very low input current. Digital multimeters have functions whereby they can test capacitors, diodes, and transistors. They can also display frequency.

The Cathode Ray Oscilloscope

The cathode ray oscilloscope is a particularly useful tool for the electronic engineer.



The most important controls that we use are:

- The vertical sensitivity setting, calibrated in V/cm.
- The time base, in s/cm.

The CRO is a perfect voltmeter as its input resistance is very high indeed.

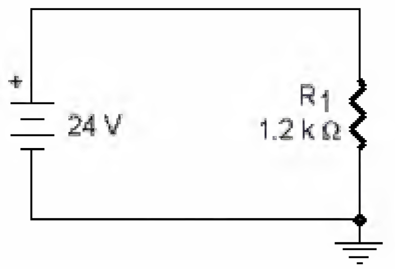
Theory Exercise

Questions

1- How will you define each of following?
   a) - Current
   b) - Voltage resistance
   c) - Resistance
2- What is the fundamental unit of electrical measurement define?
3- What is the unit of change?
4- What is the Ohm's Law?
5- What is different between permanent magnet & temporary magnet?
6- Define the unit of magnetism?
7- Describe the color codes to a resistance?
8- What is the scheme of color coding?
9- What is capacitor? Define the unit of capacitance?
10- Describe the Milli, Micro, Nano, Pico?
11- What is a diode? Describe its full function.
12- Describe the benefits of semiconductors?
13- How many types of power supplies are available?
14- What are the fuse and why there are used?
15- What is difference between AC & DC supply?
16- Define the different between analogue and digital signals?
17- What are the relays?
18- How does a voltmeter works?
19- What is a transistor?
20- How a transformer works?

Practical Exercise-1

Topic: Measurement of voltage, current, resistance in different circuit	Date:



Q. What is the voltage across R1?

Q. What is the current across R1?

Q. What is the power dissipated in R1?

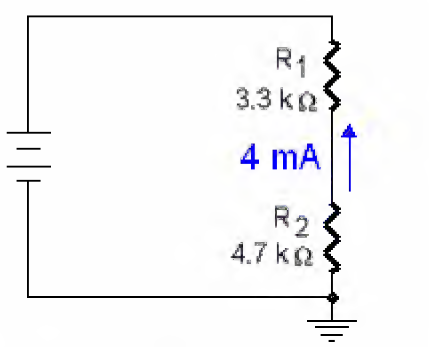
Q. What is the Voltage across R1?

Findings

Trainee Signature
Instructor's Remarks
Instructor's Signature

Practical Exercise-2

Topic: Measurement of voltage, current, resistance in different circuit	Date:



Q. What is the voltage across R2?

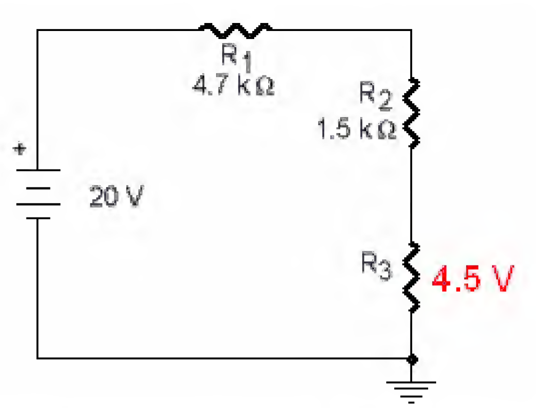
Q. What is the Battery Voltage?

Findings

Trainee Signature
Instructor's Remarks
Instructor's Signature

Practical Exercise-3

Topic: Measurement of voltage, current, resistance in different circuit	Date:



What is the current in the circuit?

What is the resistance of R3?

What is the power dissipated in the circuit?

Findings

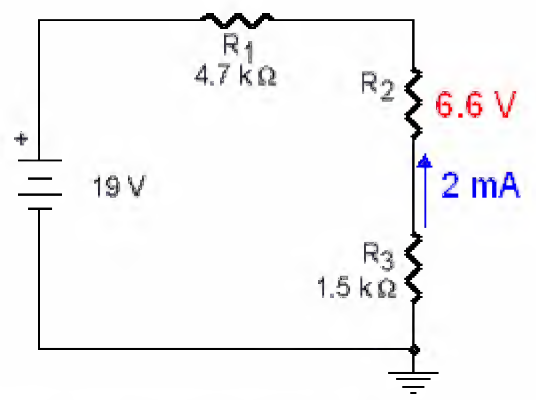
Trainee Signature

Instructor's Remarks

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Practical Exercise-4

Topic: Measurement of voltage, current, resistance in different circuit	Date:



What is the resistance of R2?

What is the power dissipated in the circuit?

Findings

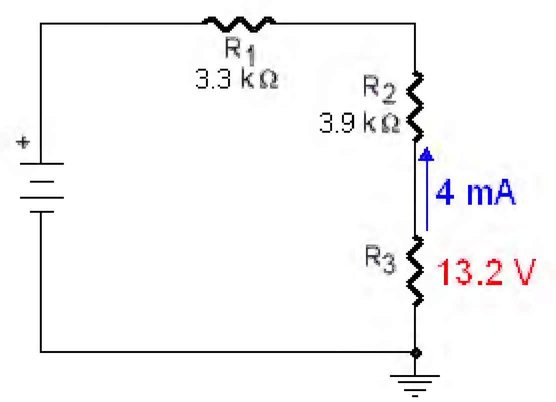
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Practical Exercise-5

Topic: Measurement of voltage, current, resistance in different circuit	Date:



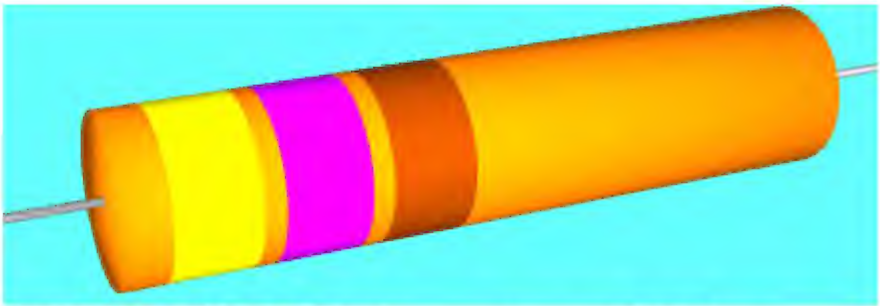
What is the Battery Voltage?
What is the resistance of R3?
What is the power dissipated in R3?

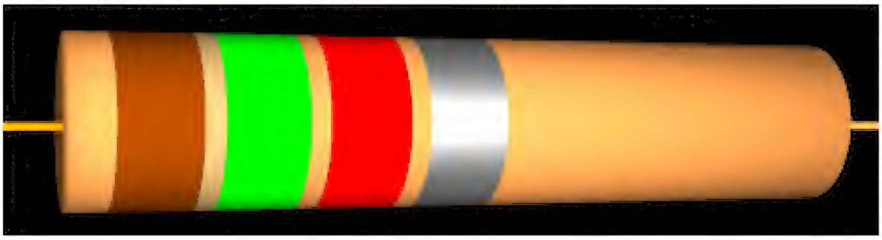
Findings

Trainee Signature
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Instructor's Signature

Practical Exercise-6

Topic: Measurement of voltage, current, resistance in different circuit	Date:





What is the resistance?

Findings

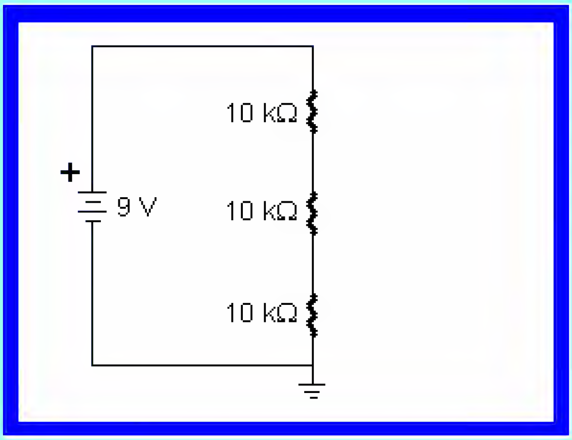
Trainee Signature

Instructor's Remarks

Instructor's Signature

Practical Exercise-7

Topic: Measurement of voltage, current, resistance in different circuit	Date:



When fault finding in resistor circuits there are four conditions to consider. Resistors fail in one of four ways:

1. Resistors can increase in resistance.
2. Resistors can become open. (resistance increases to infinity)
3. Resistors can decrease in resistance.
4. Resistors can become shorted. (resistance decreases to zero)

Findings

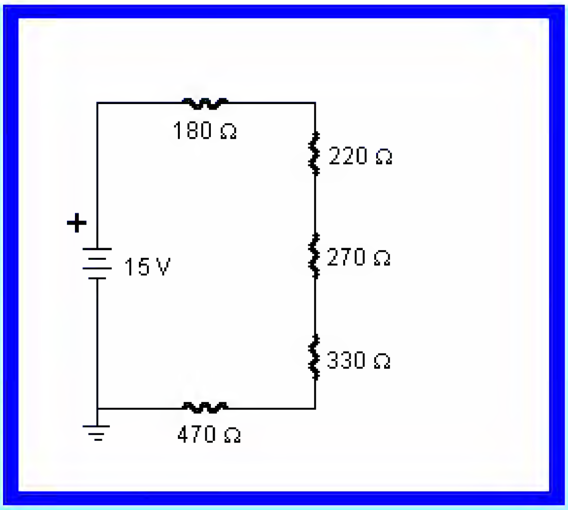
Trainee Signature

Instructor's Remarks

Instructor's Signature

Practical Exercise-8

Topic: Measurement of voltage, current, resistance in different circuit	Date:



The circuit shown is not working correctly. Looking at the circuit you can't see which component or components are defective. In practice, there may be more than one fault. For this exercise there is only a single defective component. With your test equipment you can make measurements to localize the problem.

Findings

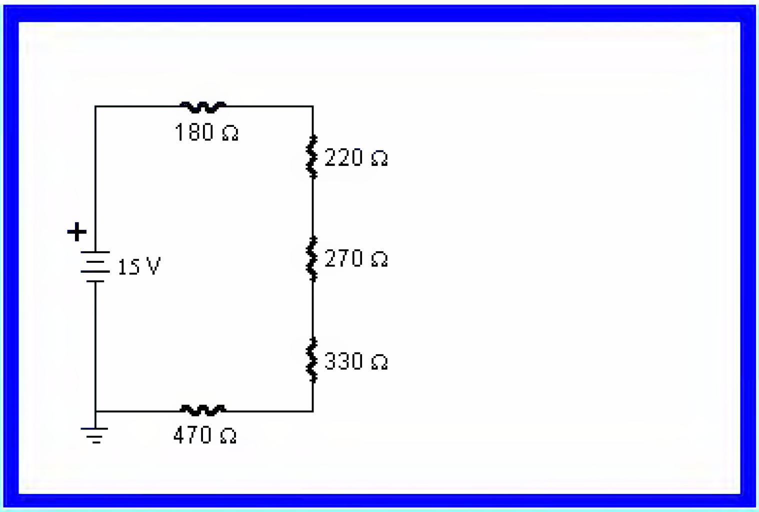
Trainee Signature

Instructor's Remarks

Instructor's Signature

Practical Exercise-9

Topic: Measurement of voltage, current, resistance in different circuit	Date:



In a circuit with only five resistors you could easily test each of the resistors with your ohmmeter. In real equipment with hundreds of parts you need to localize the problem to only a few choices before actually testing individual components. The purpose of this exercise is to practice techniques you can use to localize problems in a larger piece of equipment.

Findings

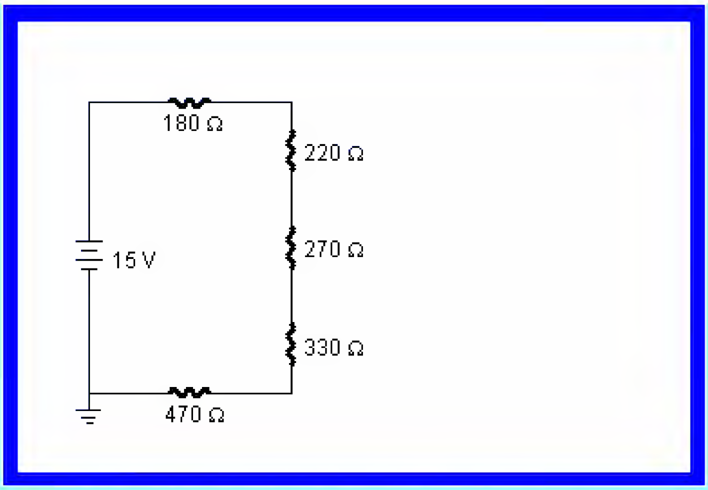
Trainee Signature

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Practical Exercise-10

Topic: Measurement of voltage, current, resistance in different circuit	Date:



You have to start by testing something. What would you like to do first?

A Test one of the resistors with an ohmmeter.

B Test the current flowing through the circuit

C Test the voltage drop across one of the resistors.

Findings

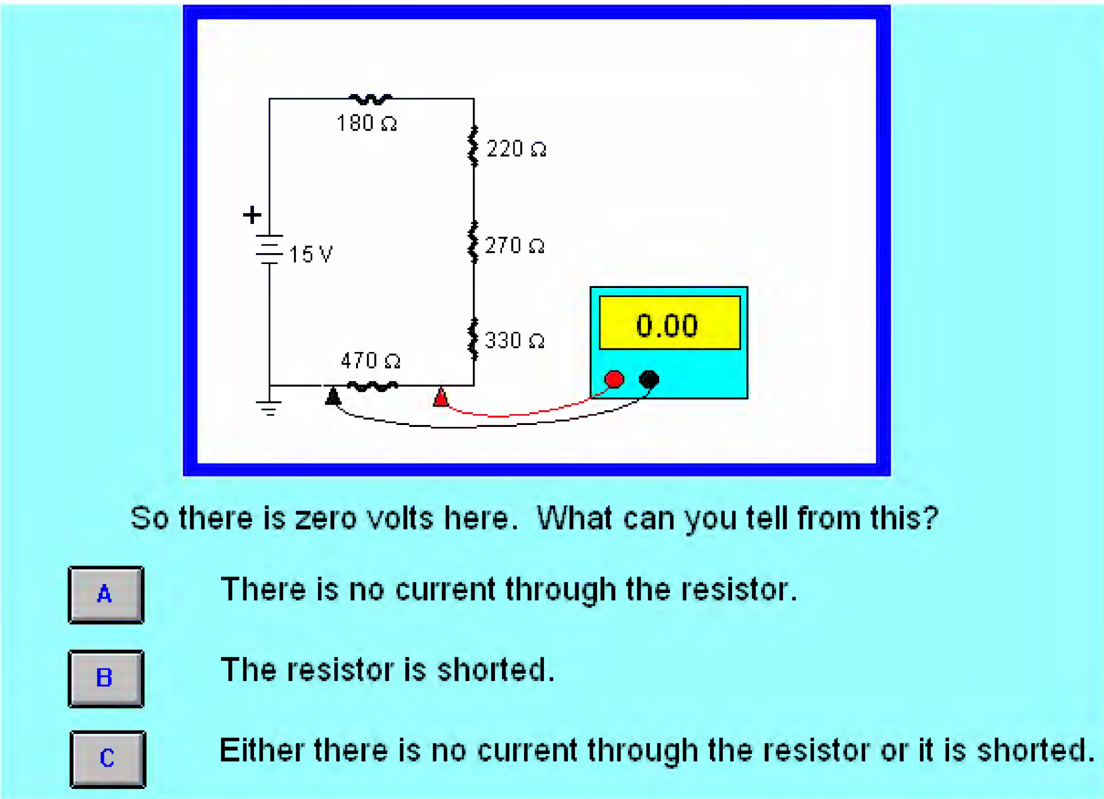
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Instructor's Remarks

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Practical Exercise-11

Topic: Measurement of voltage, current, resistance in different circuit	Date:



<u>Findings</u>

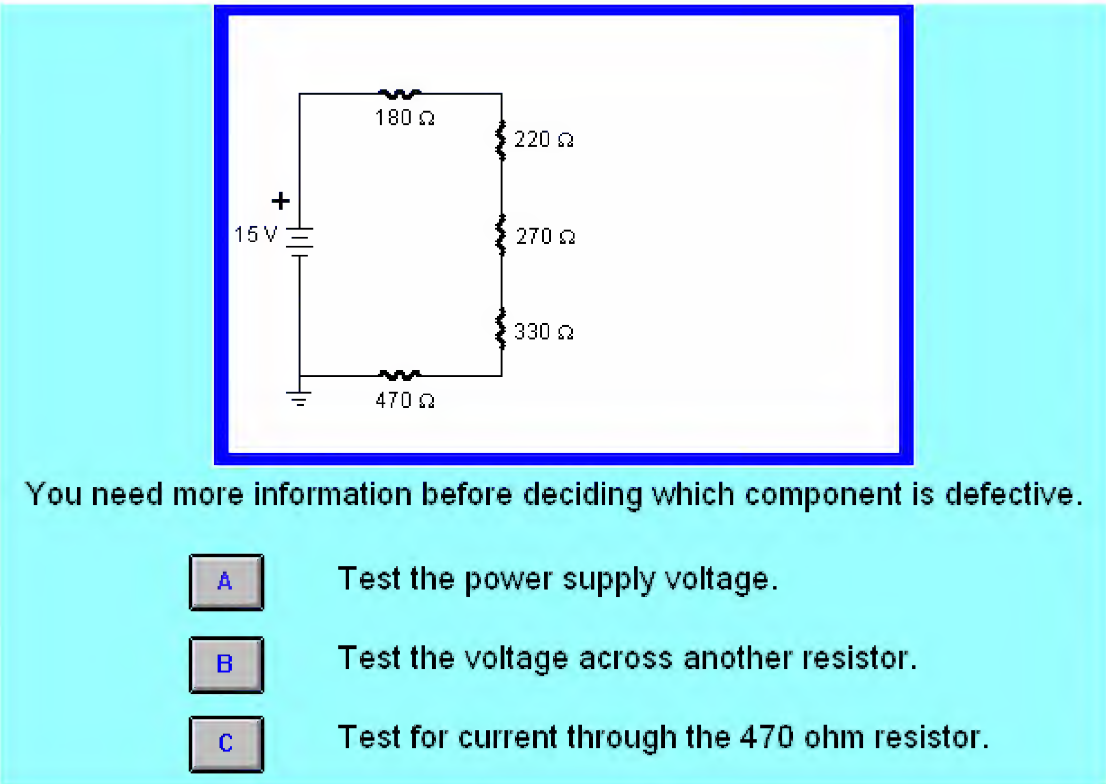
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Instructor's Remarks

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Practical Exercise-12

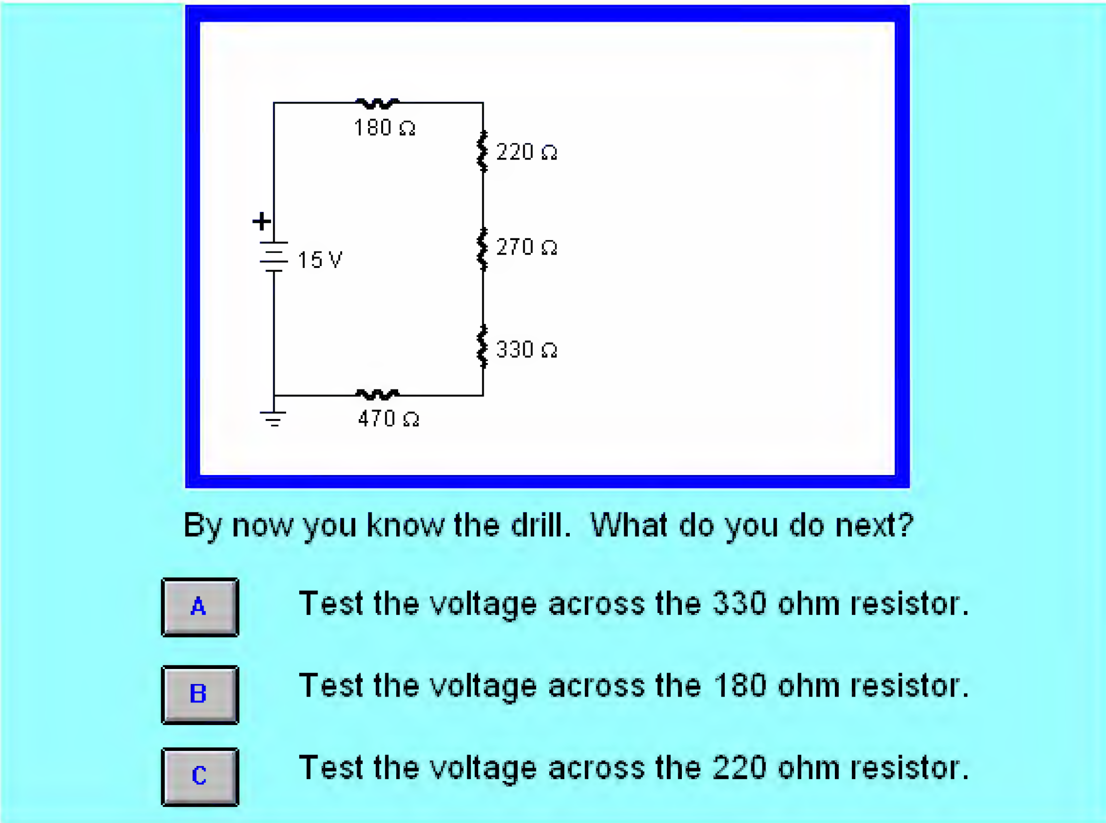
Topic: Measurement of voltage, current, resistance in different circuit	Date:



<u>**Findings**</u>
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Practical Exercise-13

Topic: Measurement of voltage, current, resistance in different circuit	Date:



<u>Findings</u>

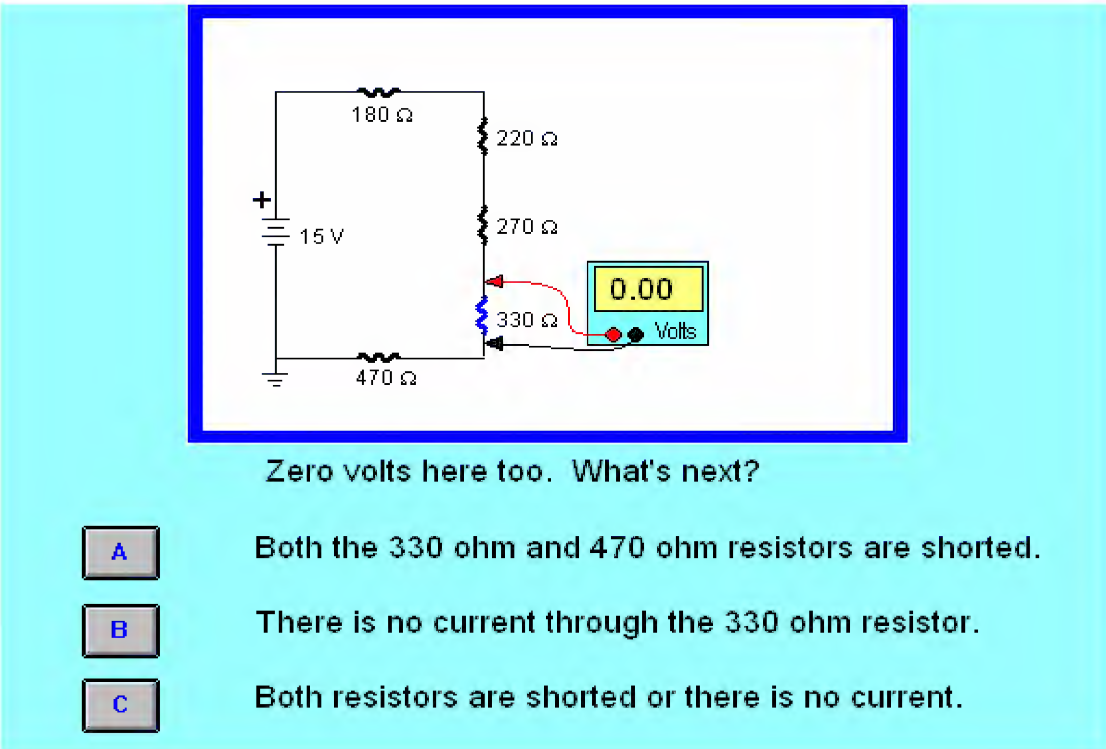
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Practical Exercise-14

Topic: Measurement of voltage, current, resistance in different circuit	Date:



Findings

Trainee Signature

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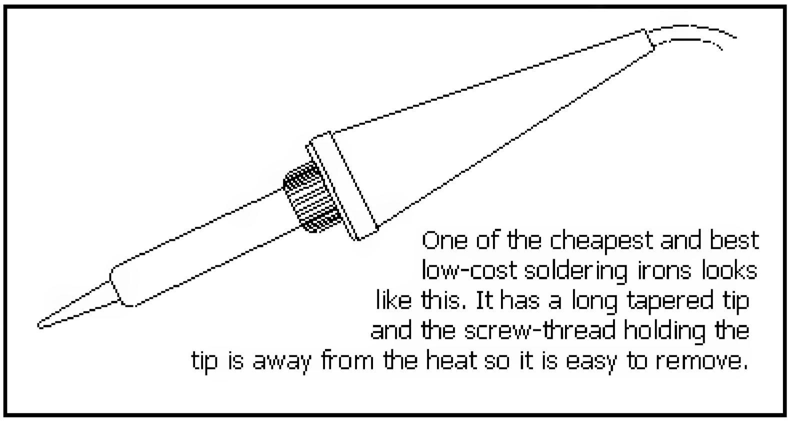
Soldering and Measurement Techniques

Introduction to Soldering

The most fundamental skill needed to assemble any electronic project is that of soldering. It takes some practice to make the perfect joint, but, like riding a bicycle, once learned is never forgotten! The idea is simple: to join electrical parts together to form an electrical connection, using a molten mixture of lead and tin (solder) with a soldering iron. A large range of soldering irons is available - which one is suitable for you depend on your budget and how serious your interest in electronics is.

Simple Soldering

The first hint: The best way to prevent damaging a component when soldering is to hold it in your fingers, while holding and pushing it onto the printed circuit board.

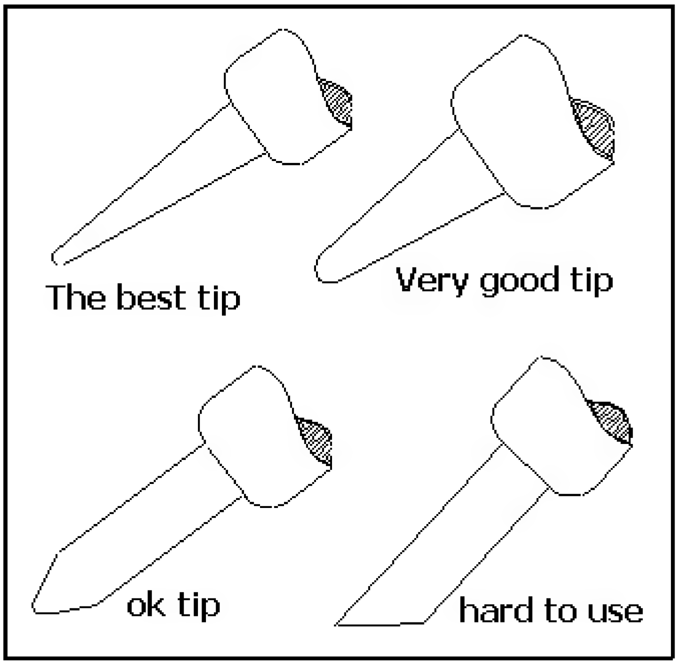


If you have to let go, the component is getting too hot. This applies especially to transistors and Leeds as they are semiconductor devices and must not be allowed to get too hot as they can be easily damaged.

Buying a Soldering Iron

There are lots of soldering irons on the market and they cost from a tiny Rs.35 to a massive Rs.1, 000 what's the difference between them and which one is best for a beginner?
If you intend to make electronics your hobby and eventually your profession, you invest in a temperature controlled soldering STATION and you will have the best from the start.

If you are not able to spend a lot of money at this stage, any of the low-cost soldering irons with a rating of 15 to 30 watts will be suitable. Don't buy a plumbers-type soldering iron with a rating of 60 watts or greater or an instant-heat soldering iron or a soldering gun as they require a lot of skill to get the correct temperature and you can easily damage delicate components.



The Size of the Tip

Sometimes a very fine tip is what you need to make a delicate joint and sometimes a small flat on the end of the tip is handy for adding solder to a larger connection. The actual shape does not matter but as you get more experienced you will find the screwdriver-type tips as shown in diagram 4 are not very nice to work with and a tapered tip with a fine point as shown in figure 1 or medium point as shown in figure 2 is professional-looking and good for all types of connections. Anything larger than this, as shown in figure 3 and 4 will not allow you to get into tight areas - especially when soldering surface-mount components.

Solder

You may think solder is an insignificant part of soldering but it is actually a highly technical item and some of the factors associated with solder help you create better

joints.

There are three points we will be covering: They are:

1. How does solder work?
2. What are the melting points for solder? And
3. How does flux work?

Solder is normally a tin-lead alloy, although other elements such as Copper, Silver, Bismuth, Indium, Antimony and Cadmium can be added to obtain certain characteristics.

Solder has three distinct states:

Solid, Plastic and Liquid

the solid and liquid states are easy to understand but the plastic region needs a little explanation. This is when the solder is beginning to change from a liquid to a solid. You can see this occurring on a joint when the shiny surface gradually becomes dull. When solder is cooling through this region, the joint must not be moved otherwise the wire or lead forming part of the joint will be very weak when the solder has cooled down. In fact if you wiggle or pull the lead it will easily come away from the joint.

This is basically how dry joints occur. If a component such as a transistor, regulator or resistor gets hot enough to pass heat down its lead and the lead melts the solder joint, the result will eventually be a dry joint, even though the original joint may have been perfect. The other condition that has to occur is the component must not be moved (such as vibration) while this solder is cooling. The result will be a fracture in the solder.

Lead melts at 327°C/621°F and tin melts at 232°C/450°F. But most of the tin/lead alloys change from solid to plastic state at 183°C/361°F.The plastic region occurs between these two states and its width varies according to the tin/lead ratio.At the 63%tin/37%lead ratio, the alloy passes from solid to liquid with no plastic region. This is termed a Eutectic alloy and the temperature at which this occurs is called the Eutectic point (183°C).

63/37 solder is not normally used in electronics as it is very susceptible to fracture at the instant of solidification due to any slight movement of the solder joint. 60/40 solder is the most commonly used as it has a very small plastic region of 5ºC (183ºC to 188ºC) and with a little care, a good solder joint is easy to make.

Solders with less than 60% tin do not wet the base metal as good as higher tin solders. They are more brittle and more likely to fracture under stress.
50/50 solder has a relatively large plastic range of 29°C, therefore more care must be taken not to disturb the joint when cooling.
When soldering, a certain amount of the base metal is absorbed into the solder. Usually this is not a problem, but if it is, special solder alloys can be used to reduce the effect.
For instance 50/48.5/1.5 (Sn/Pb/Cu) (Tin/Lead/Copper) solder will reduce the absorption of copper from unclad soldering iron tips but since most soldering iron tips are triple plated, this should not be necessary. As soon as the tip gets a hole through the plating it should be replaced with a new one.

Flux

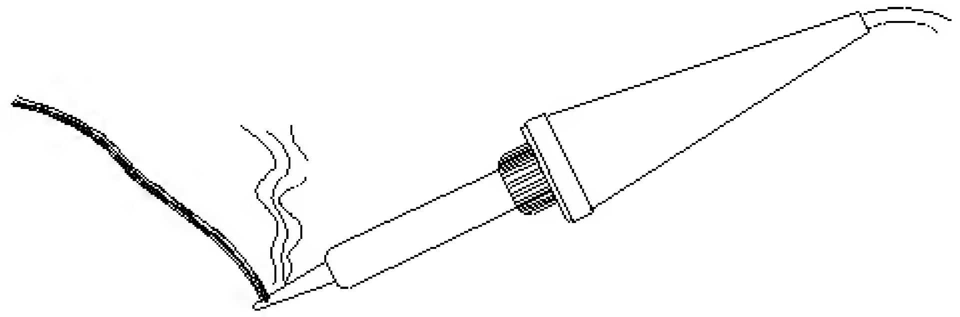
The lead of a resistor is usually plated mild steel. They are not, as you would expect, made of copper as this is very expensive and to reduce the cost of components they are a ferrous metal with a plating of nickel or tin. All these metals form an oxide layer when exposed to air and quite often they get oil and grease from fingers and the surroundings.
This oxide layer is a barrier and prevents the solder sticking to the metal. The problem becomes worse when the metal is heated as the heating accelerates the formation of the oxide layer.
This is where flux comes in. Rosin cored solder has flux in the centre of the solder. It may be a single core of flux or 5 very fine cores. Five-core solder is the best as it allows the soldering iron to heat up the flux before the solder has reached the liquid state, causing it to flow out of the solder and clean the surface ahead of the molten solder. Single core flux is more messy and comes out in spurts and bubbles. Avoid this type of solder if possible.
Rosin flux is obtained from the gum of pine trees and although it is not extremely harmful, you should never breathe the fumes. (When taking the enamel off winding wire the fumes are extremely dangerous in the gaseous state and must NEVER be inhaled. The best is to stop breathing when removing the enamel.) The diagram below shows the advancing hot solder with the flux covering the copper and removing the oxide film. A good solder joint will finish up bright and shiny with almost all the flux being evaporated during the soldering process. If you have a lot of flux left over, either the solder is not of good-quality (such as single core solder), the iron is not hot enough or a lot of dirt is present.
It is very difficult to explain on paper how to tell if a soldering iron is too hot or too cold. But if I was next to you I could tell exactly the temperature by simply watching how fast the iron melts the solder and how fast the flux creates fumes. You will

generate this skill too, after a lot of soldering. There's one final point while on the topic of flux. The life of rosin cored solder is about 5 seconds! As soon as the flux has evaporated from the solder, the remaining solder is ABSOLUTELY useless.
This means you must have the solder next to the joint so that the flux does its work IMMEDIATELY. It is useless melting the solder on the iron and then taking the iron 30cm to the joint. The solder is already DEAD and cannot possibly make a good connection. The other thing you must not do is dab, dab, dab the solder on the joint. The can leave the solder in the plastic region and can easily create a faulty connection as discussed above. Tinning the iron is the most important part of soldering, so let's look at what we mean. Here are the 2 simple steps to creating a good joint:

Step 1:
Tin the Iron

The size and shape of the tip does not matter, provided it is bright and shiny. The way to do this is to add fresh solder so that the resin (in the centre of the solder) does its job.

No matter what the size and shape, the first thing to do is TIN THE TIP by feeding one centimeter (1/2") of fine solder onto it and letting the resin in the centre of the solder clean the tip. This solder is then wiped onto a wet sponge so that no excess solder remains on the tip. This may seem like a waste of solder but it is actually the resin (or rosin) in the centre of the solder that is required. We don't want any solder that has been sitting on the iron and that's why it is wiped off.



Step 1. Tinning the iron. Add 1/2cm of solder to the tip of the iron and wipe on a wet sponge.

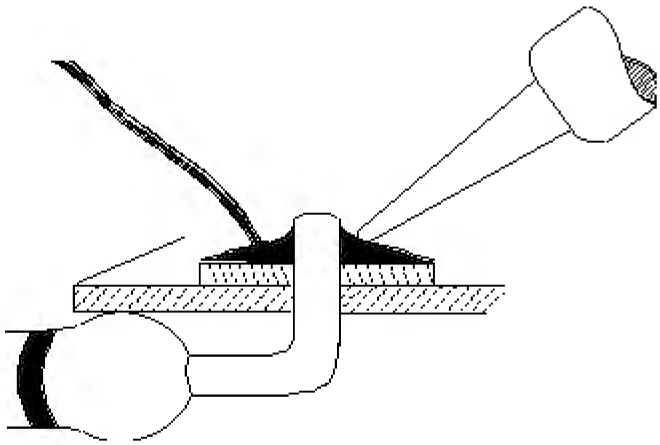
Do not use any type of plumbers soldering flux or solder paste or plumbers solder or any form of thick solder that comes without rosin in the centre.
The only two types of solder for electronic work are:

Fine: .71mm and
Standard: 1mm.

This tinning procedure is done every time the iron has not been used for 15 minutes or so. This is the secret to good soldering and unless the tip is absolutely clean (by carrying out the above process) you are simply wasting your time.
When a soldering iron is left in a hot state for 15 minutes or more, the solder on the tip oxidizes and some of the resin is left behind and is burnt to a carbon compound. This solder becomes very dirty and if you try to use it to make the next connection, it will not "stick" to the lead of the component or to the track on the PC board. It will sit on the lead or the pad on the board and create a dirty joint. Later, this will become a prime possibility for a dry joint.

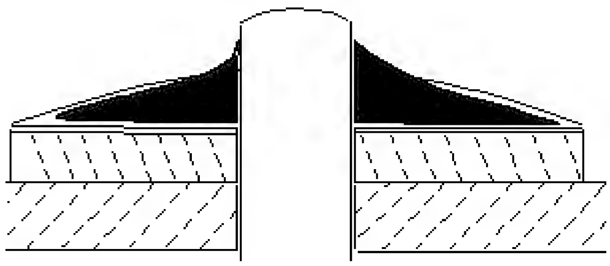
Step 2:
Heat the solder-land

The iron is then taken to the solder-land where the joint is to be made. The land and the lead are then heated for about 1 second and 1/2cm of fine solder is added to the land on the other side to the iron.



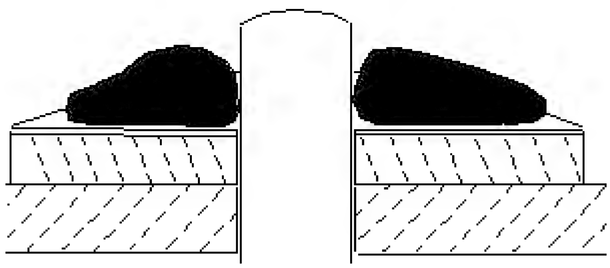
Step 2. Heat the land and lead for 1 second then add 1/2cm of solder - from the opposite side to the iron.

A good connection will have the solder licking up the side of the lead and will spread out over the solder-land as shown in the diagram below.



A good connection will look like this.

If you have not done everything correctly, the solder will not "stick" to the lead and will look like the diagram below:



A bad connection is where the solder has not "stuck" to the component lead.

The Dry Joint

A dry joint is the worst thing that can occur because it looks like a good connection but when the component is wiggled, the lead becomes loose and can be pulled away.
Dry joints look to be ok but they don't make a perfect electrical connection. They make a connection that is intermittent. This is the one thing we try to avoid and that's why you have to become expert at soldering.
Dry joints can occur after product has passed inspection. If a component gets extremely hot during use, such as a regulator or output transistor, heat passes down the leads of the component and enters the joint. The solder heats up and partially melts. When the joint cools the solder does not adhere properly to the lead and a faulty connection is produced.
The only way to eliminate this is to keep hot components on long leads or heat-sink the body so that the temperature does not raise more than "touch hot."
If any joint is constantly heated and cooled, and the lead is moved when the joint is passing through the plastic region, the solder will fracture very easily. The end result will be a "dry joint."

The Soldering Iron Stand

One last item to cover is the soldering iron stand. It is important, not only to prevent the iron falling off the bench, but for two other reasons. The base of the stand holds a sponge that must be wetted with water every time you begin soldering. You must wipe the tip of the iron before every connection to remove dirt and contamination if you want to make a perfect connection...
The base of the stand also has a tray to hold excess solder that has been tapped off the tip. Every time you make a connection, the excess solder must be tapped off so that new solder can be used for the next joint. You must ONLY use NEW solder for every connection.
If you cannot buy a low-cost stand from your local electronics store, a glass ashtray will do the job. It's not perfect substitute but will prevent the iron falling off the bench and hold a damp sponge. It is better than nothing.
If you follow the simple rules we have outlined, the quality of your soldering will improve and as you gain more experience with timing and manual dexterity, you will be able to handle finer and finer work.

Hot Air Station Soldering

Hot air for disordering any size of SMD components. The station uses the exclusive JBC system, based on protectors-extractors (See image at bottom of page) and hot-air flow, which makes disordering clean and quick, concentrating the heat on the IC, and protecting the rest of the circuit at the same time.



A medium-sized SMD can be disordered in less than 20 seconds. When the IC is at disordering temperature the extractor snaps the IC upward so fast that the leads are almost completely devoid of solder. This makes replacement of the same IC very easy if you wish.
Disordering SMTs, through hole components and cleaning of through-hole components and pads by using the disordering iron which contains an independent vacuum pump.



BGA IC & Chips Soldering

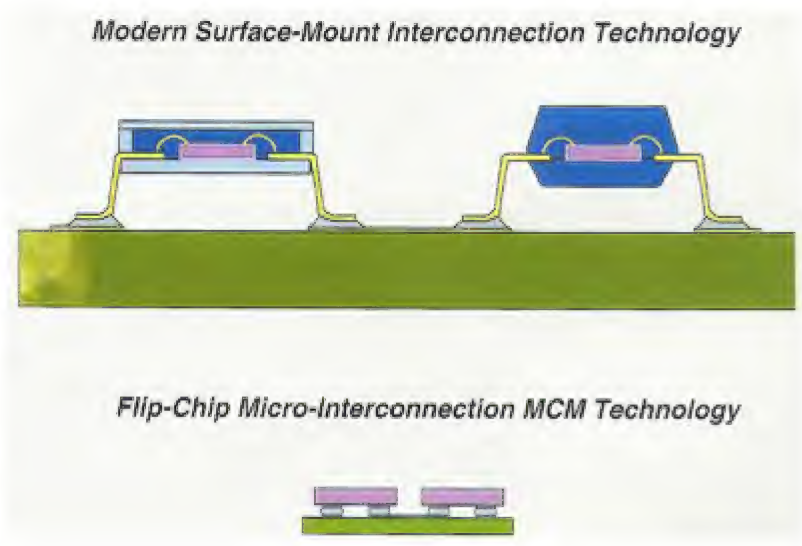
These technologies include a new Pb-free fine-pitch printed solder paste for flip-chart applications, a new silicon-on-silicon MCM architecture using an "active" silicon substrate, a high speed automated assembly process adapted from surface mount

technology, a novel BGA package designed for optimum reliability and a new printed solder paste and reflow technology for solder "bumping" the resulting MCM BGA packages.
The many advantages of the multi-chip module (MCM) architecture, (improved electrical performance, lower power demands, miniaturization etc.), have long been recognized. Unfortunately, their inherently high cost has limited their use to high end applications when performance is essential. Consequently, MCM production volumes are usually small. In most modern electronics, the engineering choices made in designing the product and the manufacturing technology for both components (e.g. ICs) and products (e.g. camcorders) have been very effective in reducing unit cost as the product volume increases. Unfortunately, this has not often been the case for MCMs where emphasis has focused on the management of complexity in ways which do not readily lead to the usual economies of scale. Recognizing this to be a fundamental inhibition to the realization of their full potential, the Micro interconnects Research Group at AT&T Bell Laboratories, MH has focused its efforts on developing MCM assembly and packaging technologies designed to improve the cost effectiveness of flip-chip multi chip modules (MCMs).
This is accomplished through the aggressive exploitation of a highly automated, high-capacity manufacturing infrastructure based, in so far as possible, on the extensive application of widely available generic tools, and the benefits of imaginative materials research. In this way the need for developing new, specialized types of MCM assembly equipment is minimized and, through the use of low cycle times and the wide spread application of batch processing, capital costs can be distributed across many MCMs so that as the volume increases the unit cost rapidly decreases.
Recently completed factory trials have demonstrated the effectiveness of this approach, and as a result, cost competitive MCM products manufactured using robust, standardized assembly processes will soon become available for large volume, low-cost product applications.

Multi chip Modules

The concept behind the MCM is shown somewhat schematically in Figure next which compares a conventional electronic circuit pack with a "flip-chip" MCM of the type chosen for the present technology. In this example, the upper diagram represents the interconnection structure relating two packaged integrated circuits (ICs) which have been surface mounted to a printed wiring board (PWB), while the lower diagram represents the interconnection structure for the same two ICs as flip chip mounted to a circuited substrate to form an MCM "tile". In general an MCM tile is a high density interconnection structure in which unpackaged integrated circuit (IC) chips or bare die are connected both mechanically and electrically onto a single substrate of silicon,

ceramic or even epoxy-glass laminate. For a variety of reasons, of which minimum overall system cost is an important example, the present AT&T MCM technology uses silicon as the substrate material and silicon IC technology to fabricate the interconnection circuitry. Its key features are the use of (1) aluminum circuit metallization, (2) polyimide dielectric layers, (3) integrated thin-film passive devices and (4) integrated bipolar devices including both diodes and transistors.



A comparison of the interconnection structure for two packages ICs surface mounted to a PWB and the same two ICs if mounted as bare chips on an MCM substrate
Most MCM designers prefer to use laminate substrates as a means of reducing cost. However, silicon technology supports (1) the realization of far greater integrated circuit and external interconnect densities and (2) the integration of additional functionality described above. Consequently, a silicon technology MCM substrate can provide far more value added than a simple interconnection network or "fabric". Besides, differences in opinion make life, and packaging, more interesting.

MCM Tile Assembly

Most of the interconnection techniques used to electrically connect to IC chips in single chip packages can be used to electrically connect the IC chips onto the substrates in multi chip module packages. Even though both wire bond and TAB (tape automated bonding) technologies are nominally cheaper, flip-chip soldering provides the best performance at the highest I/0 density for perimeter or area I/0 arrays, and requires the least substrate "real estate". This choice is further motivated by the inherently high interconnection densities that can be achieved using thin-film silicon substrates. Furthermore, flip-chip soldering is inherently a batch assembly process

which is well-suited to high-speed, high throughput applications in which the cost per unit decreases rapidly with product volume.

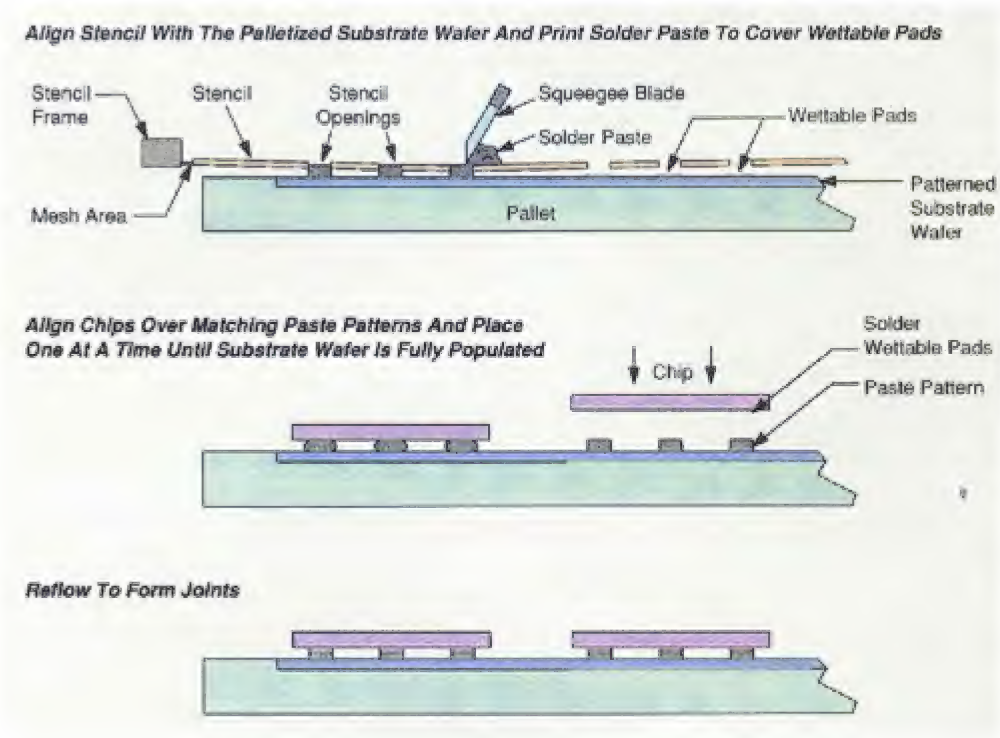
"Traditional" Flip-Chip Soldering

In flip-chip soldering as represented by the "controlled collapse chip connection" or "C-4" technology developed by IBM, both the IC chips and the interconnection substrate to which they are to be flip-chip soldered must be furnished with matching arrays of solder wet table I/0 pads. In addition, the pads on the chip are also furnished with tiny solder "bumps", of (usually) a high lead plus tin alloy. Detailed descriptions of the techniques commonly used to furnish the chips with solder wet table I/O pad metallization and the solder "bumps" are available in a number of reference publications. In general they involve sputtering, evaporation and/or plating processes which, in the interests of brevity, will not be described here except to say that the equipment involved tends to be expensive.
Classical C-4 flip-chip assembly itself begins with the application of a sticky flux to the substrate followed by chip placement and subsequent "reflow". This flux provides the adhesion needed to hold the chips in place while the rest of the substrate is populated with bumped chips, and continues through the reflow step dulling which the MCM is heated above the melting point of the solder alloy and then cooled to form solder joints. The resulting solder joints are more than an order of magnitude smaller than the solder joints usually produced by the conventional printed solder paste technology used to reflow solder surface mount packaged components to multilayer printed wiling boards (PWBs).

Low-Cost Flip-Chip Printed Solder Assembly

While it is always necessary to furnish the I/0 pads on both the chips and the substrate with solder wet table metallization, it is not necessary to furnish either with solder bumps! In many situations it may well be less expensive to furnish the solder as part of the flip-chip assembly process itself. That is, if the I/0 pitch is sufficiently large, which can often be accomplished by design. The solder can be stencil printed, in paste form, directly onto the substrate wafer prior to chip placement.
Figure next shows a step-by-step representation of this novel AT&T printed solder MCM assembly process. The basic idea is to exploit the existing infrastructure for the high-speed, low-cost assembly of electronics by adapting the well developed manufacturing capabilities of so called surface mount technology (SMT) to the assembly of silicon tiles. SMT, which was developed to assemble packaged IC chips, discrete components (resistors, transistors, capacitors and diodes) and connectors, transformers, etc. onto printed circuit boards, is a high-speed, state-of-the art

automated print, place and reflow solder based assembly technology. As shown schematically in Figuer, the flip- chip MCM tile assembly process follows the same print, place and reflow sequence as conventional SMT, except that many of the usual limitations u hitch arise for large, high-l/O SMT components simply don't apply. For example, the problems associated with fine-pitch lead co-planarity aren't relevant to bare chips all of whose solder wet table I/0 pads lay on a common plane and well within the reduced outline of the chip itself.



On the other hand, problems of limited printability and performance do arise when commercial fine-pitch SMT solder pastes are applied to silicon wafers (rather than PWBs) which had to be resolved by (1) reformulating the solder paste to assure robust printing (and assembly) onto a patterned silicon substrate wafer and by (2) reconfiguring the bare chip 10 pad perimeter arrays into area arrays by "rerouting". For many applications rerouting can readily increase the pitch from as little as 0.13 mm (5 mils) to 0.4 mm (16 mils), which is well within the range of state-of-the-art fine-pitch printing.

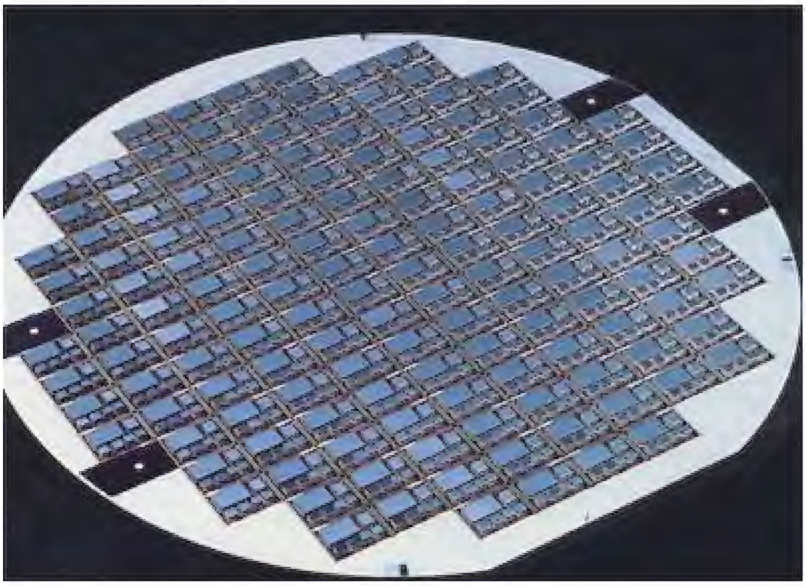
In order to achieve maximum throughput it is important to carry out the tile assembly process on entire silicon wafer (or even a ceramic panel) comprised of many substrates, rather than just one substrate at a time. This makes the most efficient use of the type of programmable high-speed automated assembly equipment that is most cost effective for large volume manufacturing. Finally, in order to make maximum use of batch processing and assure maximum through-put without compromising

yield, whole-wafer die placement is followed by whole-wafer reflow and whole-wafer cleaning prior to test and simulation.

Reflow Solder Paste

In general, solder pastes are appropriately proportioned combinations of a viscous liquid flux and a solder alloy in powder form. In order to be acceptable for use in any solder paste intended for electronic assembly, the flux must not only provide the chemical action required to assure wetting of the metal surface by the molten solder, but it must also be able to hold a lot of solder powder, resist slumping, retain the components in place throughout the assembly process, and not contaminate the electronics in any way that might cause long-term reliability problems. In addition, the AT&T YD-series flux developed for flip-chip applications is also formulated to provide optimized printing on silicon substrate wafers, hold the bare silicon chips in place throughout the assembly process, exhibit minimum spreading during assembly, facilitate excellent solder wetting and form strong, low resistance solder joints. Furthermore, it is designed to be reflowed in an inert atmosphere during which it robustly facilitates the optimum reflow realignment of each and every chip, consistent formation of well consolidated joints with few, if any, non-consolidated reflow solder balls, bridges (shorts) or opens, and minimum reflow voids of any kind. Finally, it is designed to be readily cleanable after reflow with an environmentally compatible solvent. This cleaning is essential to permit subsequent "die and wire bonding" of the tile into the MCM package for next level interconnection.

In choosing a solder alloy powder to be combined with the flux to form the solder paste, care must be taken to assure that the flip-chip solder joints in the MCM don't melt or soften during any subsequent next-level interconnect reflow process because this might well cause the tile to fail when the MCM is ultimately soldered to a PWB. Consequently, a Pb-free solder alloy, 95/5 Sn/Sb, was chosen for the flip-chip assembly paste. This alloy melts at a 240°C, well above the 1 83°C melting point of the eutectic or near eutectic Sn/Pb solder alloys commonly used for board-level electronic assembly. Since this higher melting point alloy is already widely used for electronics assembly in the industry, it is readily available in powder form at modest cost for combination with a YD- series flux to provide a robust solder paste. In addition, it has respectable, albeit not outstanding, fatigue characteristics.



Assembly R&D

The first printed solder assembly experiments were conducted using four- chip electro-mechanical test vehicles (MCM tiles with interconnection circuitry and solder wet table I/O pads only - no working IC chips or active substrates). In most of these initial experiments whole wafers of over 100 tiles each were assembled in a little more than 34 minutes using an early solder paste formulation and inverted chip pocket tape die handling. This remarkable figure represents the elapsed time as measured from alignment of the palletized silicon substrate wafer in the printer through chip placement from the pocket tape into the printed paste by the SMT placement machine to the end of reflow in the inert atmosphere belt furnace. Such performance is an example of the high through-put automated process required for low-cost, high-volume MCM assembly. In these initial unoptimized experiments 416 chips were placed on each wafer in slightly over 20 minutes, which represents less than 3 seconds per chip! Furthermore, the 34 minute input-to-end cycle time represents an overall assembly rate of around 5 seconds per chip, or 20 seconds per four-chip tile. X-ray and two probe continuity testing gave an assembly yield of 96% on a per module basis, and well over 99.96% on a per joint basis on electromechanical test vehicles with I/O pitches ranging from 0.34 mm to 0.51 mm (13.5 mils to 20 mils).

In order to assure robust assembly and to simplify routing on the active silicon substrates used in the design of working MCMs, all prototype silicon substrates were designed for chips with solder pads routed to area arrays with readily printable pitches of 0.41 mm to 0.43 mm (16 mils to 17 mils). Subsequent experiments involved the successful flip-chip assembly of more than fifteen wafers of the both prototypical six-

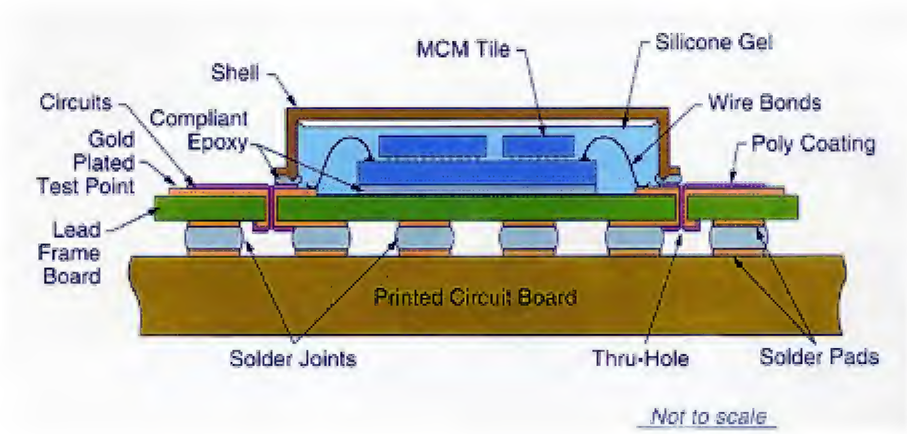
chip daisy chain electro-mechanical test vehicles, as well as numerous wafers of working silicon MCM tiles. Figure above shows one such prototype MCM wafer assembled during successful factory trials held in the AT&T Shreveport Works in Louisiana. Following appropriate process refinements and design improvements, the capacity for high-speed, high-yield silicon MCM-D tile assembly using a surface mount type placement machine was confirmed and qualified.

MCM Packaging

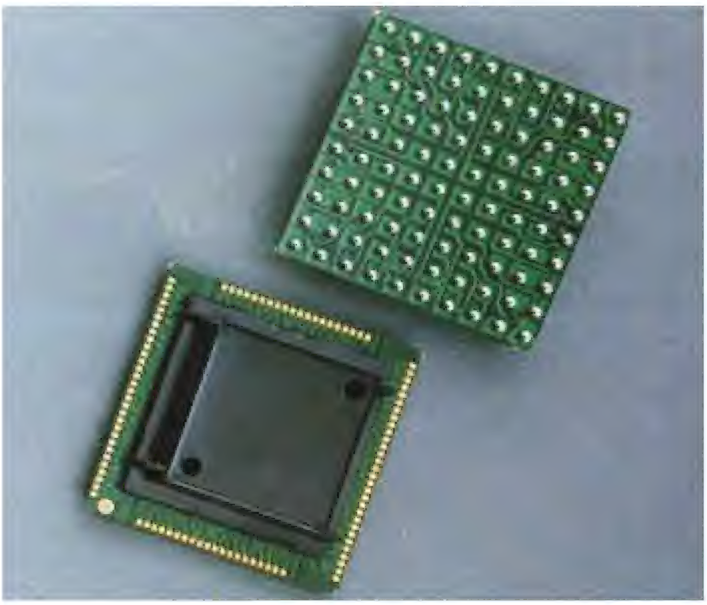
As with any bare silicon device or IC, an MCM tile must be packaged to facilitate automated handling for next level assembly and assure protection from the environment (mechanical, chemical and thermal). At the same time this packaging must provide the reliable electrical interconnections and performance under all anticipated service and specified qualification conditions. In order to best provide these many interconnections and at the same time meet the objective of minimum overall system cost, two alternative MCM BGA packages were developed. One used conventional over molding and the other used a novel shell and gel encapsulation. The latter, more unique design is described below.

Shell and Gel BGA MCM Packaging

The shell and gel BGA was designed to produce a structure in which the thermal expansion mismatches between the tile, the shell, the BGA PWB and the mother board is almost completely accommodated by minimizing the mechanical coupling between them. This is accomplished by using a highly compliant epoxy adhesive to attach both the tile and the shell to the BGA PNVB, by using compliant wire bonds to electrically connect the tile to the PWB circuitry, and by filling the shell with an even more compliant, commercial silicone gel as shown schematically in Fig. 4. This approach leaves the bottom surface of the silicon tile and the BGA PWB relatively free to expand and contract during changes in temperature. Considering that the CTE of the BGA PWB is in the range of 12 to 15ppm/C and that the CTE of the silicon tile is much lower, being on the order of 2 to 4ppm/C, this behavior is highly desirable.



This package was also designed to be assembled, into-far-as-possible, using standard packaging and SMT type equipment. After assembly on PWB panels of ten Bags each, the under sides of the BGA PWBs were solder "bumped" by printing with a second proprietary YD series Pb/Sn solder paste. This paste is then "reflowed" to form an individual 0.8mm diameter solder ball on each BGA I/O pad. Figure below shows two such packages after being assembled, solder "bumped" and separated into individual MCM Bags. One is oriented to show the upper surface of the BGA PWB with the shell covering the tile, and the other is oriented to show the under side with the resulting solder bumps.



Monolithic packages such as those produced by over molding depend on mechanical strength, inherent stiffness and interfacial adhesion for their robustness and long-term reliability. On the other hand, because such a design emphasizes the effects of the

CTE mismatches between MCM components, low-cycle thermal fatigue may cause wear-out of the solder joints, especially those connecting the BGA to its parent board. This problem becomes more severe as the MCM becomes larger, so that an alternative over molded package design which can provide the needed long-term service life for a small tile or single chip may not be able to do so for a much larger tile or chip. However, a more loosely coupled design like the shell and gel should not have these limitations. Consequently, so long as it works as intended and at the same time satisfies the standard packaging requirements for low cost, automated handle ability, excellent electrical performance and high resistance to the effects of moisture, the shell and gel design represents a logical alternative for long term BGA packaging reliability.

All by itself the silicon-on-silicon MCM tile is a relatively low risk structure for thermal fatigue related to on-chip power dissipation, and a very low risk structure for thermal fatigue related to environmental temperature changes. Consequently, unless the packaging itself interferes with the mechanical relationship between them, the solder joints which interconnect the chips with the silicon substrate will experience little stress or strain during thermal cycling and should be highly reliable in service. However, it is possible that the solder connections to the mother board could be at some risk. Intrinsically, the BGA PWB and the mother board to which it will be soldered are of laminate materials which have the same or nearly the same CTE. Therefore, if (1) there were no other components in the package (which there are, however) and (2) there are no significant thermal gradients (which may also occur), the solder joints connecting the BGA and the mother board will be nearly free of stress and strain. However, both the shell and the tile have rather different CTE values. Consequently, unless the effort to uncouple them from the BGA PWB is successful, thermal stresses can develop in the BGA to mother board solder joints, with an ultimately negative impact on attachment reliability. This would certainly be the case with a monolithic over molded BGA design. However, so long as the design of the shell and gel BGA structure is successful in uncoupling these components so that the effects of the CPE mismatches among the silicon tile, the BGA PWB and the shell (and the gel are minimized, the BGA-to-mother board solder joints should also be relatively free of thermally induced stress or strain.

Shell and Gel BGA Thermal Strain Measurements

As noted above, the reliability of the shell and gel MCM BGA depends on the design's success in mechanically uncoupling the various MCM BGA components so that they can expand and contract independently such that little or no strain would be imposed on the interconnections between them. In order to assess the shell and gel design in this regard, a study of the induced thermal strains was made using a highly sensitive optical technique called Moiré Interferometer. A complete, detailed

description of these studies, which were carried out by B.T. Han and Y. GAO of IBM using the IBM Moiré Interferometer in Endicott, NY, is given in the paper by Jimetal.
Morre Interferometer is a whole-field optical technique which is described in detail in the recently published text by Post et al. In an application to electronic packaging the specimen to be studied is first sectioned through the region of interest and a high frequency diffraction grating is replicated on the exposed flat surface. When the specimen is deformed, in the present instance by cooling from 82°C to 22°C, the specimen grating deforms with it. In order to reveal the entire field of deformation, laser illumination is used to generate a virtual grating of twice the frequency of the deformed specimen grating. The resulting high contrast moiré fringes can readily be seen and recorded. Each such fringe represents 0.417 microns of in-plane displacement or deformation.
Obviously, if the specimen is of uniform CTE and temperature, the moiré fringe field would appear as uniformly spaced, parallel straight lines - vertical lines for the horizontal or u-displacement field and horizontal lines for the vertical or v-displacement field.
Figure next shows the u- and v- displacement fields as obtained under the conditions described above for the shell and gel package. Naturally, no specimen grating could be replicated on the gel portion of the package, so the corresponding region of that interferogram is dark, as is a small corner portion of the shell to which the replicated grating failed to adhere. So also are the flip-chips on the MCM tile which were out of the plane of the section, which was taken through the fourth row of BGA-to-mother board solder joints. However, for the most part these fringe fields "tell the story", although it must be understood that the short range irregularities seen in the v-displacement field fingers formed on the BGA PWB and the mother board are due to the fiber laminate structure of the composite itself, and have no influence on reliability.
With this in mind, the relatively uniform and parallel fringe patterns in the figure clearly demonstrate that, as intended, the critical components of this unique BGA package move independently and with little unwanted interaction - indeed, the silicon tile substrate, the BGA PWB and the mother board are all essentially free of thermally induced strain. At the same time, there is some inevitable flexing or bending of the shell. However, thanks to the compliance of its coupling to the PWB, very little of this is transmitted to the package. As a result, except for minor distortions due to the local CTE mismatch between the the solder and the laminate, all of the BGA solder joints are also virtually strain free, not just those at the center of the package.





Qualification and Reliability Testing

Subsequently, evaluations of pre-production samples demonstrated that the shell and gel MCM BGA design met or surpassed the required performance specifications for every one of the standard qualification tests including -55°C to 125°C Temperature Cycle Tests, MILSTD 883 (methods 2002 and 2007) Mechanical Shock and Vibration Tests, MIL-STD method 2019 Die Shear Tests, IEC 695 Flammability Tests, 1000hrTHB (85°C, 85%RH, 5v) Tests, AT&T X19435 ESD (500v and 1 000v) Tests and HTOB (High Temperature (1 25°C), Operating Bias) Life Tests. In addition, thermal cycle tests (0-100°C, 72 cycles/day) of mother board mounted pre-production MCM BGA samples (59 of each design) demonstrated superior attachment reliability for both. Despite being only non-optimized pre-production samples, the shell and gel packages experienced no wear out failures until they had completed well over 4500 cycles. Based on the appropriate acceleration factors, the survival of even 1200 thermal cycles indicates a five year service life - an important attachment reliability milestone. Both of the BGA MCM packages successfully passed this milestone.

Because of its loosely interconnected mechanical structure and relatively open design, the shell and gel package is far from hermetic and can readily take up water, etc. Not surprisingly, concern has been expressed regarding the "popcorn effect", which is the term used to describe a catastrophic mechanical failure mode related to the abrupt vaporization of entrapped water in any non-hermetic package or component during a reflow soldering process. Thanks to the design and materials choices exercised in developing the shell and gel package and described above, repeated experiments in

which BGA MCM packages have been immersed in water for hours prior to being removed and put through a standard (to well over 200°C) reflow process have consistently demonstrated no "popcorn" failures. In addition, sample shell and gel packages which were subjected to over 100 hours of 85/85 THB followed by 5 reflow cycles also showed no failures, even after four repetitions. These results clearly demonstrate that the AT&T shell and gel MCM BGA packages can be stored and handled without having to provide special protection from either atmospheric or processing derived moisture.
As a result of these studies, it is apparent that the shell and gel MCM BGA package was successful in meeting its design objectives, and offers an effective approach to the packaging of extremely large chips and MCM tiles where the problem of CTE mismatch is compounded by size. In addition, the shell and gel design is fully compatible with SMT assembly. This means that the BGA packages can be fabricated, solder bumped and assembled to the mother board using standard SMT type high-speed printing and assembly equipment (even the die attach adhesive and the solder bumps are printed).

PCB, CPU & TX Soldering

There are two axis Cartesian Robots designed specifically for selectively soldering through-hole and odd form components into surface-mount and mixed technology PCBs from the bottom side without inverting the PCB. Either system is ideally suited for applications where the product has many solder sites. All sites are soldered simultaneously for maximum productivity.



These systems feature a dynamic flux station, a pumped solder reservoir, an optional Pre-Heat station and a PCB/work holder that conveys the product through the process under robotic control.

Applications

- Selective soldering through-hole components (connectors, power supplies, coils, relays, batteries and odd-forms) Ideal for accessing sites inside of assembly cases or sites shadowed by obstructions
- Rework, remove and replace connectors, etc.
- Lead tinning of SMT or leaded components
- Other applications include: Lead frame attach, Coil lead attach, Solder coating

Features

- Configured for bottom side processing
- Quick change site specific solder nozzles
- Uses process specific subroutines for varying thermal demands (Flux volume, solder temperature, emersion depth, travel speed, dwell, etc.)
- Unlimited storage of program recipes
- SPC Data Logging
- Meets UL, CE and SMEMA requirements
- Camera assisted setup and teach function
- Designed for pass-through conveyor or batch operation.

Benefits

- Multi-Capability of Selective soldering, lead tinning and rework all with one machine
- Non-contact soldering
- No need to reflow top sided components (SMTs) when soldering only a few joints
- Will solder sites up inside of housings and avoid protruding obstacles
- Will tin component lead in high volumes
- Eliminate bridging and cycling

Options

- Pre-Heater (I.R. or forced hot air)
- Intelligent 3 axis selective spray fluxed
- Fume extraction and treatment

- Nitrogen blanket over solder pot
- Dross removal skimmer
- Automatic solder level replenishment
- Barcode recognition software
- Custom "Mass" flux and solder nozzle configurations
- On board nitrogen generator
- Board handling conveyors and stackers
- Delta-T inline pre-heat ovens (see Delta-T data sheet)
- Standard and custom lead tinning fixtures articulating vacuum head (used for tinning QFPs)
- Tilt axis (used for soldering fine pitch connectors, etc.
- 180 Rotary Axis (used for tinning axial components)

Solder Pot

Temperature Controller (0-350°C)   3°C
Lead free compatible

Solder Pot with N2 Blanket



Nozzle Area (usable) quick change nozzles 5" x 8" 12" x 12"
Solder Capacity 300 lbs 750 lbs
Re-circulating closed loop speed controlled pump

Flux

(-2 or -3) dip flux, or intelligent

The Flux Station



Re-circulating bath with quick change nozzles
Optional intelligent 3 axis spray or drop jet

Control System

Integrated Pentium PC controller and SVGA LCD color monitor
Machine operating system — Windows NT/2000

Introduction to Measurement

Electronics is about getting electrical currents to do more interesting things, beyond heating, lighting, and driving electric motors. Electronic devices have made a major impact on society in the areas of:

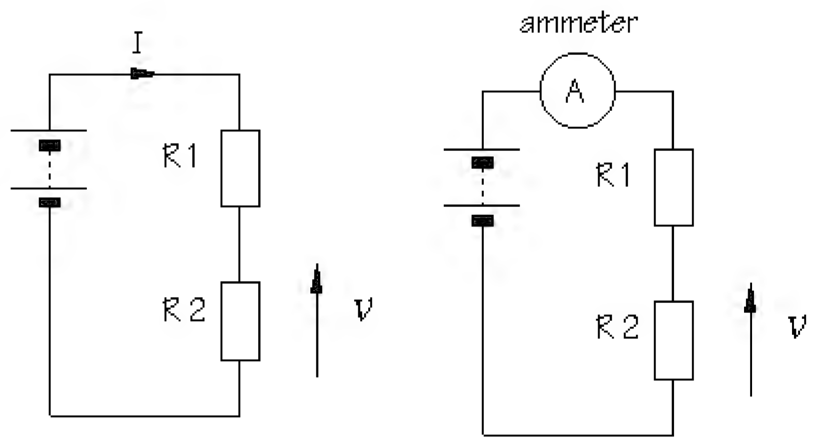
Entertainment – TV, Hi-fi, Digital broadcasting

Telecommunications – land based and mobile telephony

ICT – computers, both in commerce and at home.

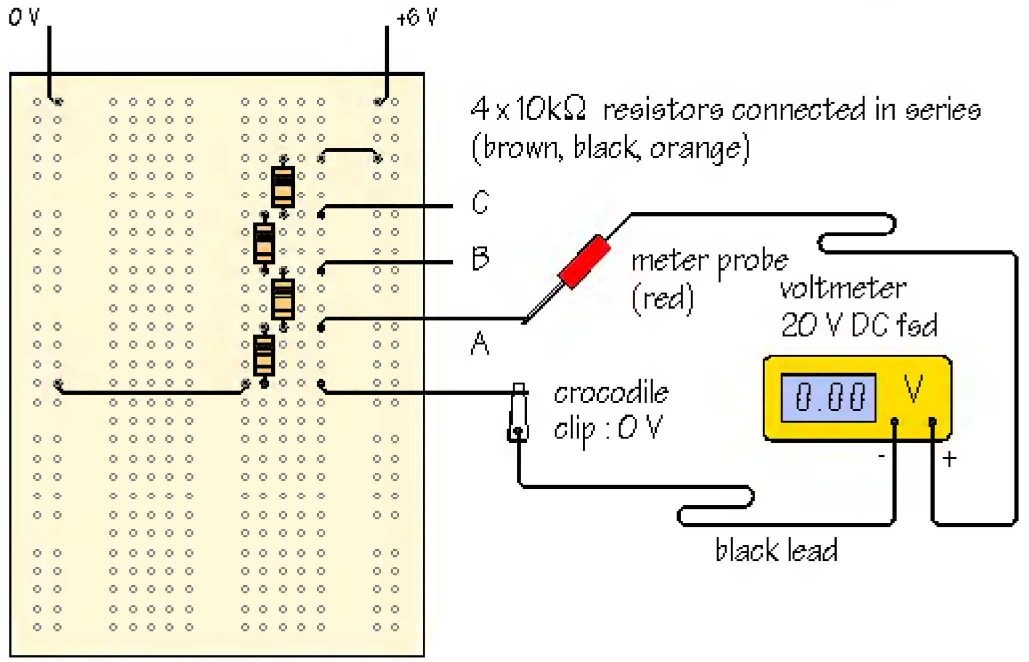
A meter is a measuring instrument. An **ammeter** measures current, a **voltmeter** measures the potential difference (voltage) between two points, and an **ohmmeter** measures resistance. A **multimeter** combines these functions, and possibly some additional ones as well, into a single instrument.

Before going in to detail about multimeters, it is important for you to have a clear idea of how meters are connected into circuits. Diagrams below show a circuit before and after connecting an ammeter:



Voltage measurement

Build the circuit shown below using prototype board and four 10 kΩ resistors:

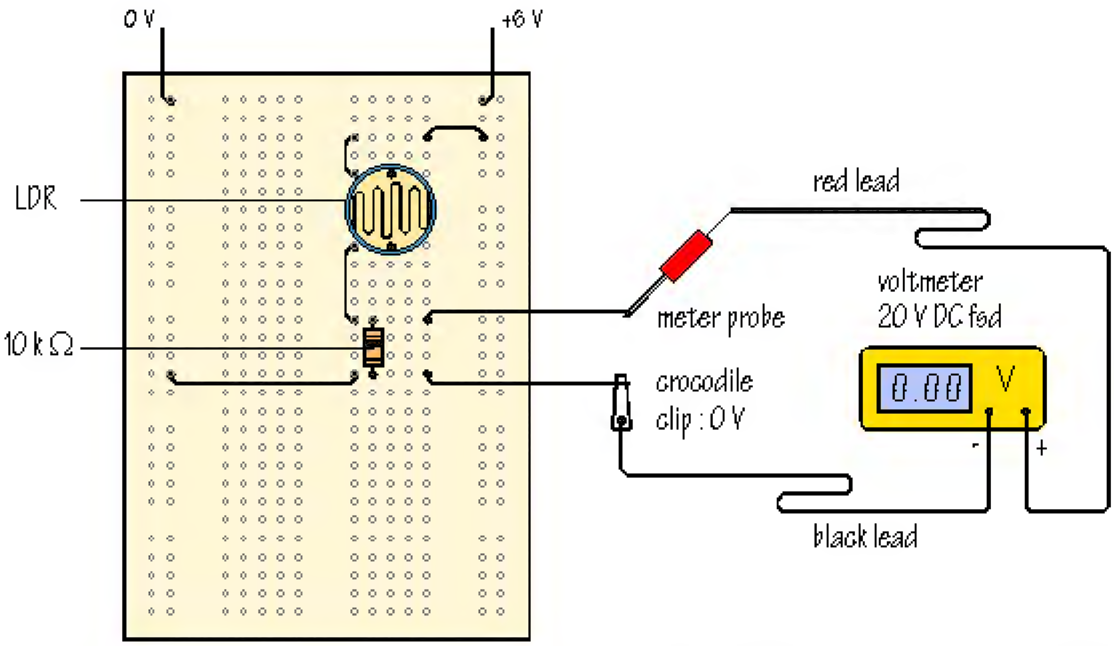


Using the multimeter as a voltmeter, measure the power supply voltage and then measure the voltages at points A, B and C.

The four resistors are connected in series, making a chain known as a **potential divider**, or **voltage divider**. The total voltage is shared between the four resistors and, allowing for tolerance, each resistor receives an equal share. (You will find out a lot more about potential dividers in the next Chapter.)

Modify the circuit, replacing one or more of the 10 kΩ resistors with 1 kΩ or 100 kΩ values. Are the results as you expect?

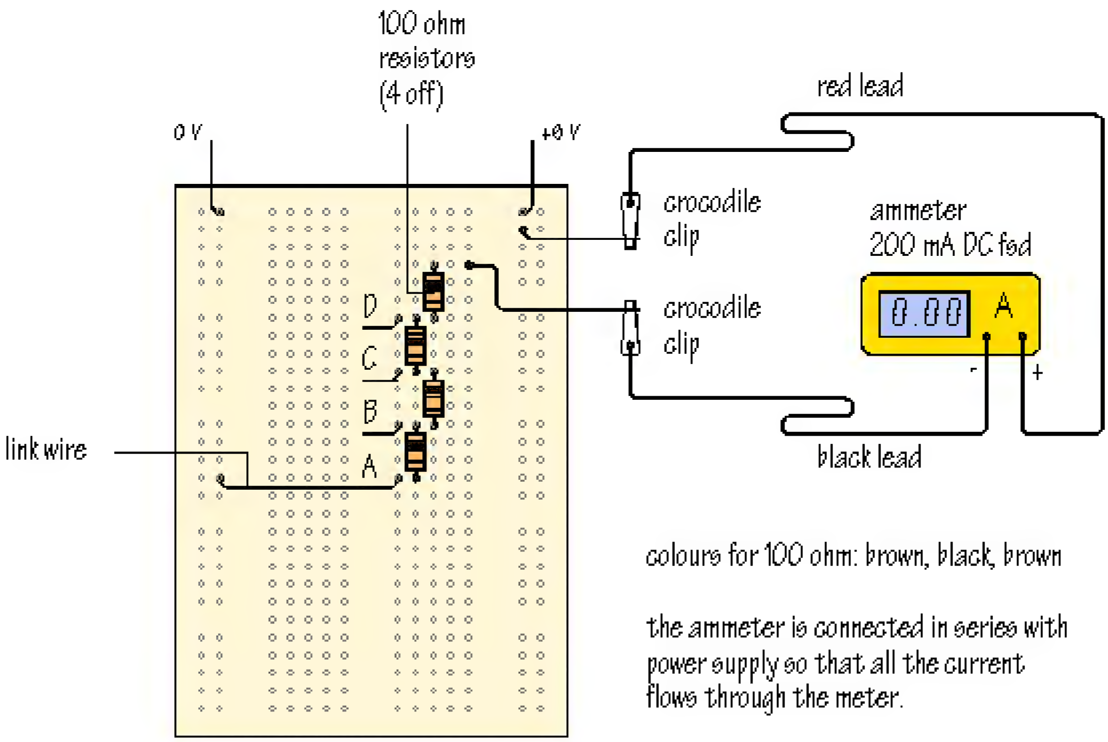
The diagram below shows a **light sensor** circuit built in a similar way:



The circuit uses an **LDR**, or **light dependent resistor**. The resistance of the LDR changes with illumination. In the dark, the resistance is high, up to 1 MΩ or more. When light shines on the LDR, the light energy increases the number of charge carriers available to transfer current, and the resistance falls. In bright light, the resistance can be as little as 100 Ω.

Current Measurement

The diagram below shows a prototype board set up for the measurement of current:



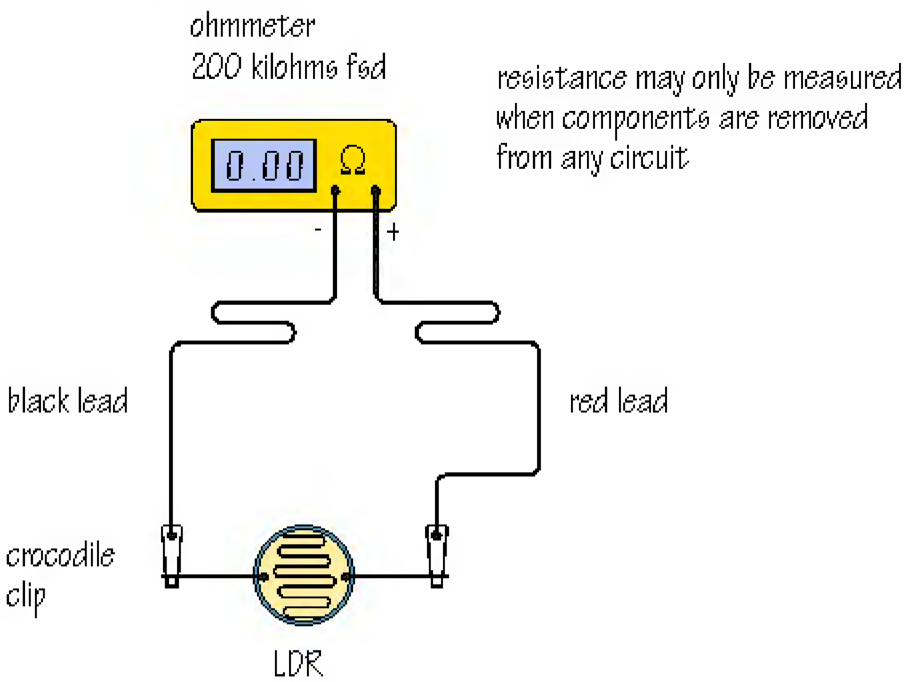
Note that the current must flow *through* the ammeter in order to reach the circuit.
Take a reading of the current with the link wire to 0 V in position A. Write down the current value you observe:
Take new readings after moving the link to positions B, C and D:
Don't forget to write in the measurement units of your answer.
As the resistance is reduced, current increases. Calculate the current expected in each case using the formula:

$$I = \frac{V}{R}$$

Small variations, up to ±5%, can be attributed to the tolerance of the resistors

Resistance measurement

Remove the LDR from the circuit and measure its resistance, as follows:



To get the millimeter to function as an ohmmeter, you will need to select a resistance range. With a switched range meter, the 200 k position is usually suitable. You will see the resistance measurement change as the light level changes. Covering the LDR with your hand increases the resistance of the LDR.

If the meter reads  this means that the resistance is more than the maximum which can be measured on this range and you may need to switch to a new position, 2000 k, to take a reading. (How many megohms is 2000 k?)
You can check the value of any fixed value resistor in the same way, and confirm that you have worked out the colour code correctly.

Use of Oscilloscope

The **cathode ray oscilloscope** is a particularly useful tool for the electronic engineer.



The most important controls that we use are:

The **vertical sensitivity** setting, calibrated in V/cm.

The **time base**, in s/cm.

The CRO is a perfect voltmeter as its input resistance is very high indeed.

Remember:

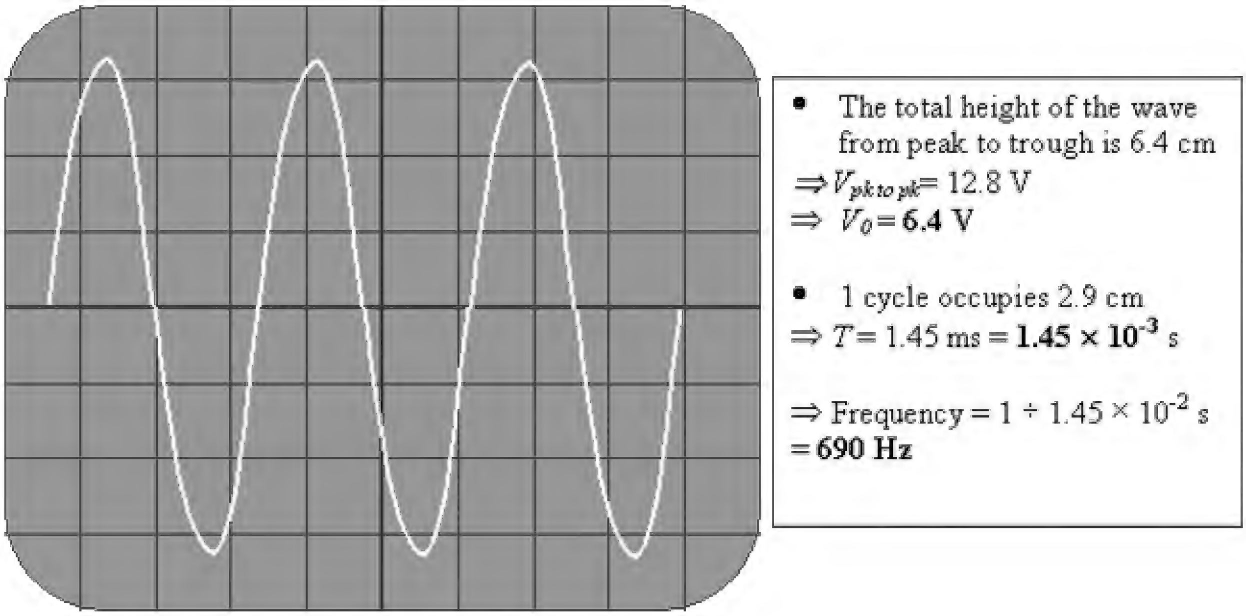
We measure the **voltage** on the **vertical** axis. We can adjust the sensitivity by turning the knob marked **y-gain** or **voltage gain**.

The horizontal direction is determined by the **time base** setting. We can change this by using the **time base** knob.

As well as analysing the waveform, there are two measurements we can make with the CRO:

We can determine the peak voltage of the AC waveform shown below.

We can also read the period, which in turn allows us to work out its frequency.



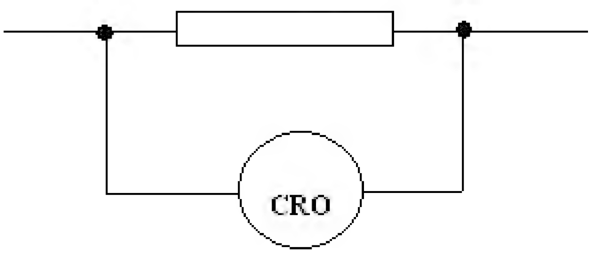
Notice that:

The **peak to peak voltage** is 12.8 V. Often engineers read the peak to peak voltage off the CRO as the determination of the 0 level is not always easy. The **peak voltage** is half of the peak to peak voltage.

The root mean square voltage, which we use in electrical calculations, is the peak voltage divided by √(2)

Therefore the *Vrms* = 6.4 ÷ √2 = **4.5 V**

We can use the CRO as a voltmeter by placing it in **parallel** with a component. We can also use it as an **ammeter** by placing it across a resistor of known resistance.



Theory Exercise

Questions

1. What is the difference between soldering iron and soldering station?
2. What is the approximate price of soldering iron?
3. Which type of electronics components can be desold from simple soldering iron?
4. How dry joints occur?
5. What is Flux?
6. What is Hot air soldering?
7. What is BGA Chips Soldering?
8. What is PCB CPU & TX Soldering?
9. What is Voltage Measurement?
10. What is the Use of Oscilloscope?

Fill in the Blanks.

1. The best way to prevent damaging a component when soldering is to _____________it in your fingers
2. The cost of soldering iron ranges from _____________ to _________________
3. There is also a _______________ controlled soldering STATION.
4. The low-cost soldering irons with a rating of _________ to _____________ watts.
5. The melting points for solder is _________________________.
6. The components such as a ____________ or ___________ gets hot enough to pass heat.
7. Lead melts at _____________°F and tin melts at __________________°F.
8. The only two types of solder for electronic work are:
   Fine: ._____________________mm.
   Standard: _________________mm.
9. Hot air is used for desoldering any size of ___________ components.
10. There are two axis Cartesian ________ designed specifically for selectively soldering.
11. Multimeter can be used to measure ______________ and ________________.
12. Current is measured from ________________.
13. Voltage is measured from ___________________
14. Resistance is measured from _________________
15. CRT stands for ___________________

Practical Exercise-1

Topic: Instructor will give the students a circuit board to desold the components	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Practical Exercise-2

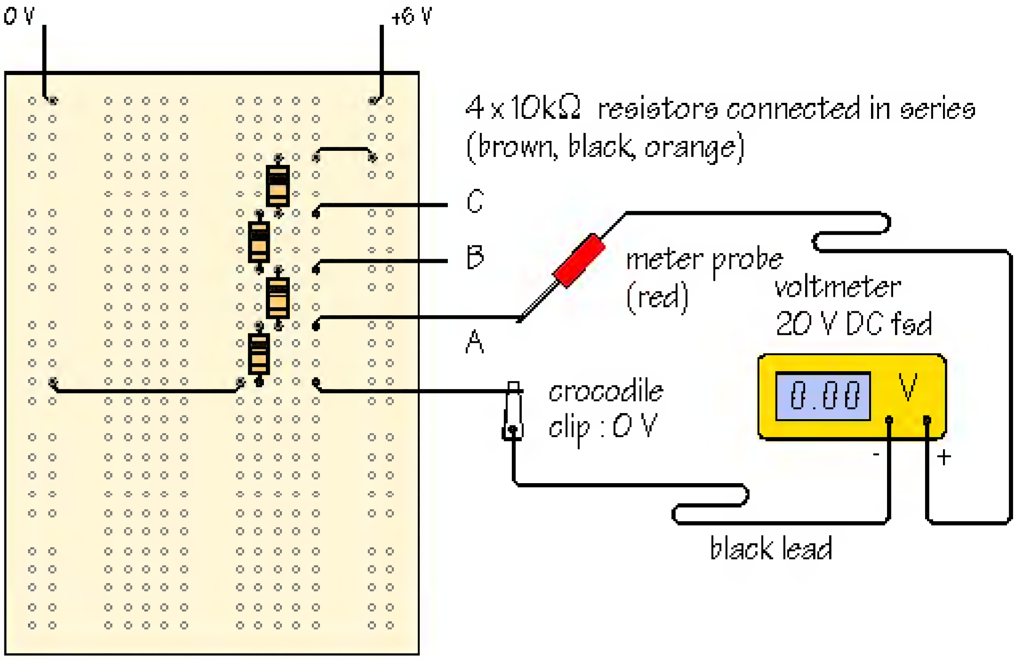
Topic: Instructor will ask the students to fix some components to the different boards.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Practical Exercise-3

Topic: Instructor will ask the students to find the different values by using components to the circuit board.	Date:
Findings	
Trainee Signature	
Instructor’s Remarks	
Instructor’s Signature	

Practical Exercise-4

Topic: Instructor will ask the students to fix some components to the circuit board..	Date:



Findings

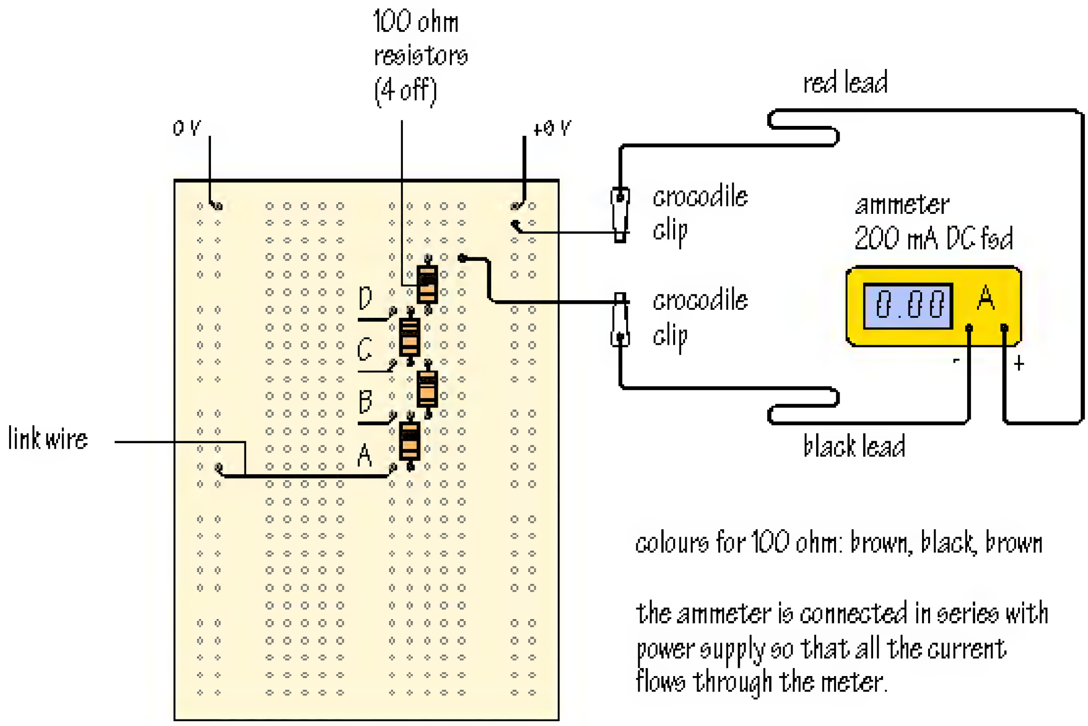
Trainee Signature

Instructor's Remarks

Instructor's Signature

Practical Exercise-5

Topic: Instructor will give the assignment to the students to fix some components to the circuit board.	Date:

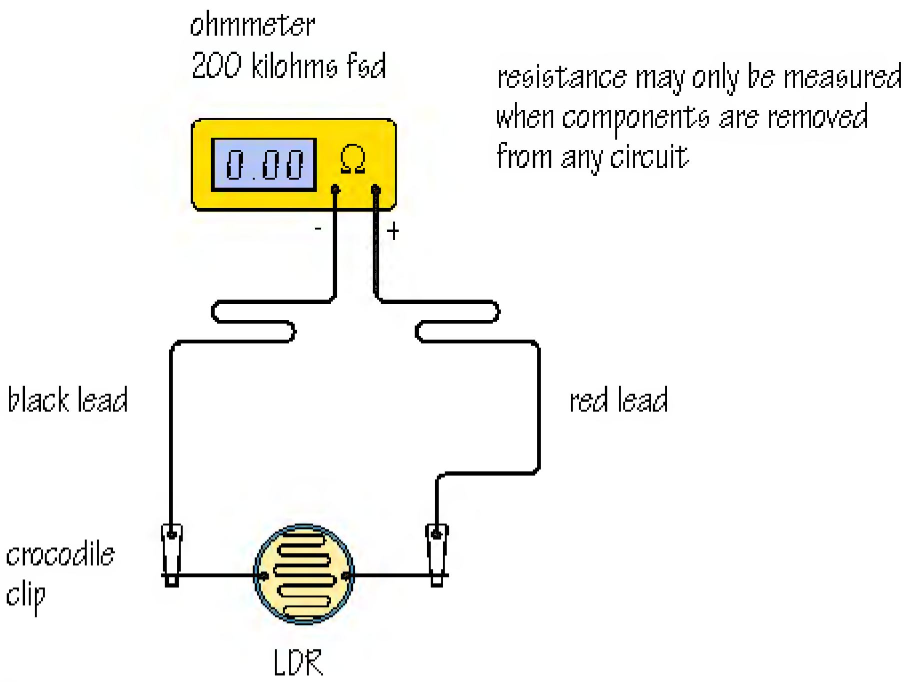


Findings

Trainee Signature
Instructor's Remarks
Instructor's Signature

Practical Exercise-6

Topic: Instructor will give the assignment to the students to fix some components to the circuit board.	Date:



Findings

Trainee Signature
Instructor's Remarks
Instructor's Signature

History of Communication

History of Cellular System

In the early 1980s the widespread use of mobile phones was just a dream, but today they are as much a part of our everyday lives as those other miracles of modern electronics - satellite television and laptop computers. It is difficult to believe that it was only in 1996 when the Pakistan public first had access to a proper mobile telephony service, and that subsequently mobile phones have become so inexpensive as to be considered just another consumer product. The mobile phone is nowadays found almost everywhere, and it has not only revolutionized the way we communicate, it has had a profound effect on the lifestyles of hundreds of millions of people. The great surge in demand for mobile phone services has inevitably put pressure on the cell phone carriers to increase network capacity, and also to reduce their call charges.

All too often the general public takes these technological advances for granted, but the rate of progress that has occurred in mobile communications was only achievable after the investment of a great deal of time, effort and money. The rapid spread of the mobile phone depended largely on the corresponding development in a range of hardware and software technologies, and the international co-operation necessary to agree common standards between companies and between countries.

The telecommunications industry has been very sensitive to market demands, so that in less than 20 years mobile phones have developed from basic 1G (First Generation) analogue systems, capable of only handling voice, to the sophisticated services offered by the latest 3G (Third Generation) systems, which are digital and can handle data as well as voice. During the development process we have also passed through 2G (Second Generation) systems, which are digital but with a limited ability to handle data, and 2.5G systems, which are a sort of transitional standard between 2G and 3G. This is the first in a series of articles describing how cellular phone networks are organized, the techniques they employ to handle calls, the technologies that are used in the design of the equipment, and how mobile communication systems have developed over time and will develop in the future.

1G - First Generation networks

First Generation mobile phone networks were the earliest cellular systems to develop, and they relied on a network of distributed transceivers to communicate with the mobile phones. First Generation phones were also analogue, used for voice calls only, and their signals were transmitted by the method of frequency modulation. These

systems typically allocated one 25 MHz frequency band for the signals to be sent from the cell base station to the handset, and a second different 25 MHz band for signals being returned from the handset to the base station. These bands were then split into a number of communications channels, each of which would be used by a particular caller. In the case of AMPS, the first 1G system to start operating in the USA (in July 1978), each channel was separated from the adjacent channels by a spacing of 30 kHz, which was not particularly efficient in terms of the available radio spectrum, and this placed a limitation on the number of calls that could be made at any one time. However, the system was a multiple access one, because a second caller could use the same channel, once the first caller had hung up. Such a system is called " frequency division multiple access " (FDMA). In addition, because the cell transmitter's power output is restricted and designed to cover a specific area, it is possible to use the same frequencies in other cells that are far enough away for there to be no interference - this system is called frequency re-use, and enables the network capacity to be increased. The cellular structure of the network is also responsible for another feature of cell phone communications, i.e. that it is necessary for some sort of handover to take place when the mobile phone passes from one cell area to another, and this requires that the pair of frequencies used by the phone are changed at the time of handover. NMT 450, the Nordic Mobile Telephone System using the 450 MHz band, was the first cell phone network to start operating in Europe (i.e. Scandinavia) in 1981. Later, in 1985, the United Kingdom began operations with its TACS (Total Access Communications System). With the introduction of 2G networks, the 1G phone were destined to become obsolete, as they were not adaptable to the new 2G standards and also had other drawbacks, such as their poor security due to the lack of encryption, and the fact that anyone with a receiver tuned to the right frequency could overhear the conversation.

2G - Second Generation networks

Second Generation mobile telephone networks were the logical next stage in the development of wireless systems after 1G, and they introduced for the first time a mobile phone system that used purely digital technology.

The demands placed on the networks, particularly in the densely populated areas within cities, meant that increasingly sophisticated methods had to be employed to handle the large number of calls, and so avoid the risks of interference and dropped calls at handoffs. Although many of the principles involved in a 1G system also apply to 2G - they both use the same cell structure - there are also differences in the way that the signals are handled, and the 1G network are not capable of providing the more advanced features of the 2G systems, such as caller identity and text messaging.

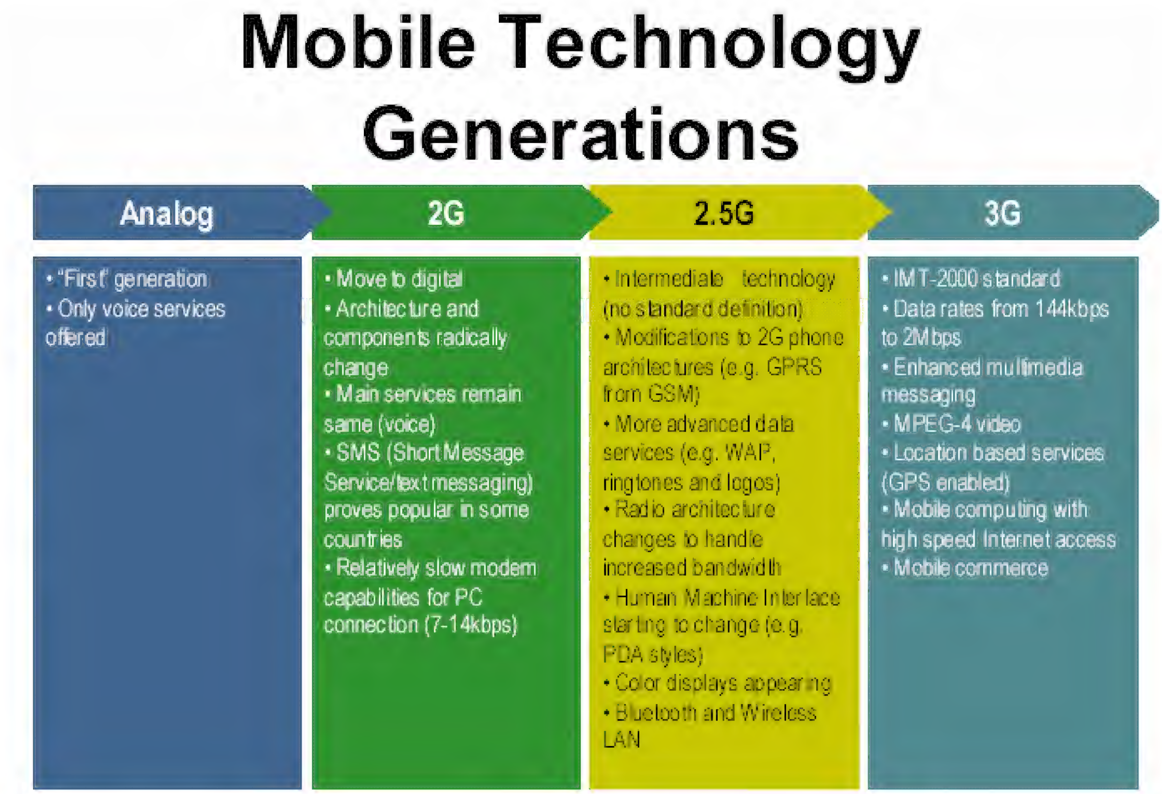
One of the successful 2G digital systems is GSM, a mobile phone standard that was developed during the 1980s, and is currently under the control of the ETSI. With the benefit of a well-specified system, commercial GSM services were able to start operating in Europe in mid-1991. The GSM system is able to utilize any of the three frequency bands at 900, 1800 and 1900 MHz , and many GSM phones can operate as dual- band or tri-band phones, whereby they are adaptable to the local frequency system in the region the user travels through. In GSM 900, for example, two frequency bands of 25 MHz bandwidth are used. The band 890-915 MHz is dedicated to uplink communications from the mobile station to the base station, and the band 935-960 MHz is used for the downlink communications from the base station to the mobile station. Each band is divided into 124 carrier frequencies, spaced 200 kHz apart, in a similar fashion to the FDMA method used in 1G systems. Then, each carrier frequency is further divided using TDMA into eight 577 us long "time slots", every one of which represents one communication channel - the total number of possible channels available is therefore 124 x 8, producing a theoretical maximum of 992 simultaneous conversations. In the USA, a different form of TDMA is used in the system known as IS-136 D-AMPS, and there is another US system called IS-95 (CDMAone), which is a spread spectrum code division multiple access (CDMA) system. CDMA is the technique used in 3G systems.

3G - Third Generation networks

Third Generation mobile telephone networks are the latest stage in the development of wireless communications technology. Significant features of 3G systems are that they support much higher data transmission rates and offer increased capacity, which makes them suitable for high-speed data applications as well as for the traditional voice calls. In fact, 3G systems are designed to process data, and since voice signals are converted to digital data, this result in speech being dealt with in much the same way as any other form of data. Third Generation systems use packet-switching technology, which is more efficient and faster than the traditional circuit-switched systems, but they do require a somewhat different infrastructure to the 2G systems. The benefits of higher data rates and greater bandwidth mean that 3G mobile phones can offer subscribers a wide range of data services, such as mobile Internet access and multimedia applications. Compared to earlier mobile phones a 3G handset provides many new features, and the possibilities for new services are almost limitless, including many popular applications such as TV streaming, multimedia, videoconferencing, Web browsing, e-mail, paging, fax, and navigational maps. The Third Generation mobile communication standard was a programme led originally by the ITU (International Telecommunications Union) under the IMT-2000 project, which generated a family of standards for use in 3G devices and networks, and they

are generally defined under the title of Universal Mobile Telecommunication Service (UMTS).
Japan was the first country to introduce a 3G system, which was largely because the Japanese PDC networks were under severe pressure from the vast appetite in Japan for digital mobile phones. Unlike the GSM systems, which developed various ways to deal with demand for improved services, Japan had no 2.5G enhancement stage to bridge the gap between 2G and 3G, and so the move into the new standard was seen as a solution to their capacity problems. Despite all the good intentions, that the IMT-2000 specification would become a single, global and standardized 3G system, this has not worked out in practice, and three different versions of 3G systems have developed, each one evolved from an existing 2G system. This is an understandable evolutionary route, as leading telecommunications companies have invested vast amounts of resources into their network infrastructure and spectrum allocations, and it was not practical to simply change from one system to another. The main 3G technologies include UMTS and cdma2000â„¢, with Europe settling on the UMTS with wideband CDMA (W -CDMA) as its chosen approach, whilst in the USA the cdmaOne networks will be upgraded to CDMA2000, a multicarrier CDMA (MC-CDMA).
It is generally accepted that CDMA is a superior transmission technology, when it is compared to the old techniques used in GSM/ TDMA. WCDMA systems make more efficient use of the available spectrum, because the CDMA technique enables all base stations to use the same frequency. In the WCDMA system, the data is split into separate packets, which are then transmitted using packet switching technology, and the packets are reassembled in the correct sequence at the receiver end by using the code that is sent with each packet. WCDMA has a potential problem, caused by the fact that, as more users simultaneously communicate with a base station, then a phenomenon known as â€œcell breathing a€• can occur. This effect means that the users will compete for the finite power of the base stationâ€™s transmitter, which can reduce the cellâ€™s range â€“W-CDMA and cdma2000 have been designed to alleviate this problem. The Third Generation of mobile phones is also designed for global roaming throughout Europe, North America and Japan, and will be widely available in many countries during 2004. However there are problems due to the different standards, and so it is still necessary for phones to be multi- band or multi-mode for widespread roaming. A 3G phone may have to make use of existing 2G and 2.5G networks where the 3G service is unavailable. The operating frequencies of many 3G systems will typically use parts of the radio spectrum in the region of approximately 2GHz (the IMT-2000 core band), which were not available to operators of 2G systems, and so are away from the crowded frequency bands currently being used for 2G and 2.5G networks. UMTS systems are designed to provide a range of data rates, depending on the userâ€™s circumstances, providing up

to 144 kbps for moving vehicles (macro cellular environments), up to 384 kbps for pedestrians (microcellular environments) and up to 2 Mbps for indoor or stationary users (Pico cellular environments). In contrast, the data rates supported by the basic 2G networks were only 9.6 kbps, such as in GSM, which was inadequate to provide any sophisticated digital services.

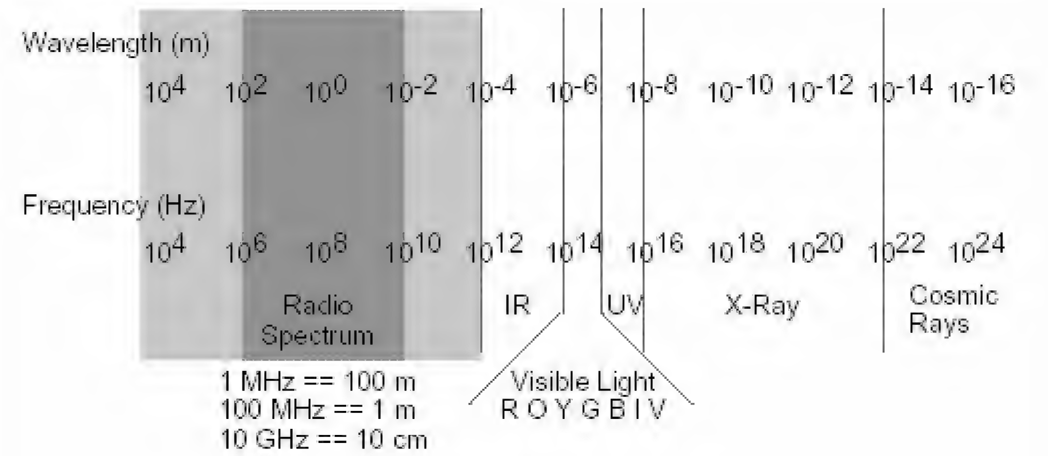


Millions of people in the Pakistan and around the world use **cellular phones**. They are such great gadgets -- with a cell phone, you can talk to anyone on the planet from just about anywhere!

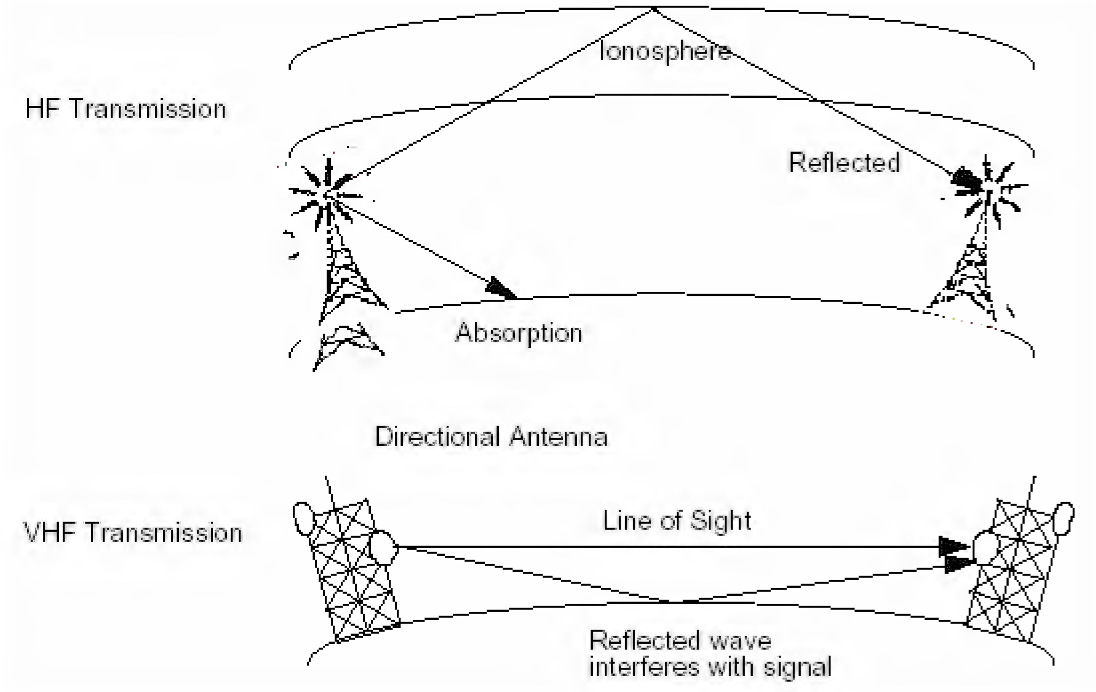
These days, cell phones provide an incredible array of functions, and new ones are being added at a breakneck pace. Depending on the cell-phone model, you can:

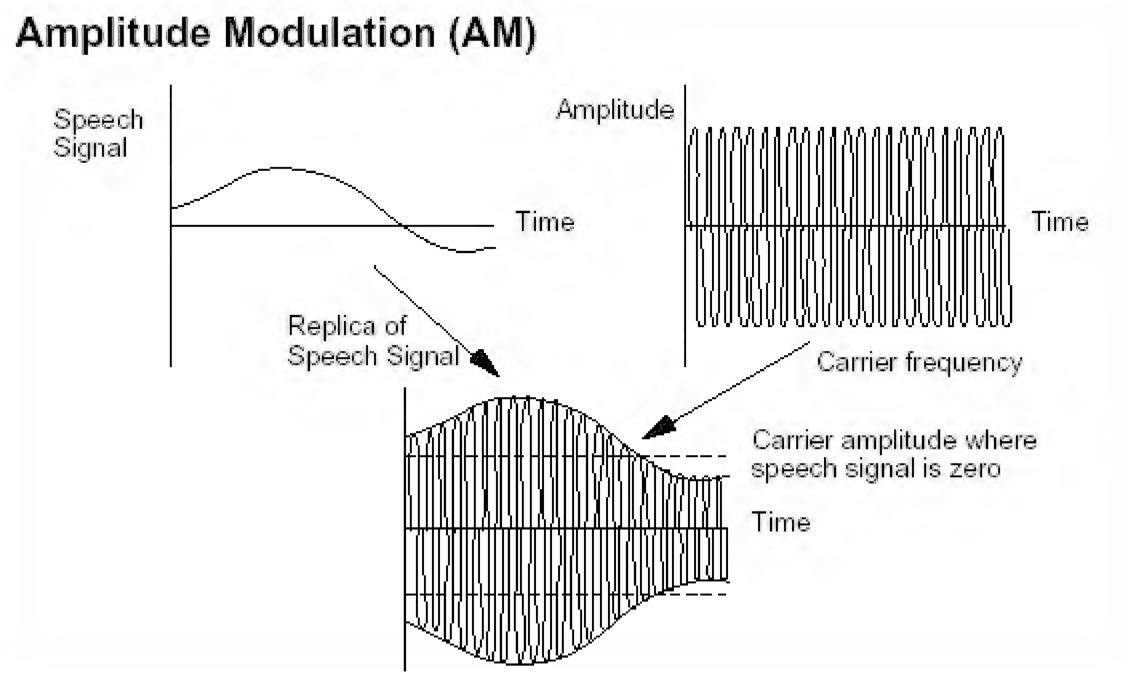
- Store contact information
- Make task or to-do lists
- Keep track of appointments and set reminders
- Use the built-in calculator for simple math
- Send or receive e-mail
- Get information (news, entertainment, stock quotes) from the Internet
- Play simple games
- Integrate other devices such as PDAs, MP3 players and GPS receivers

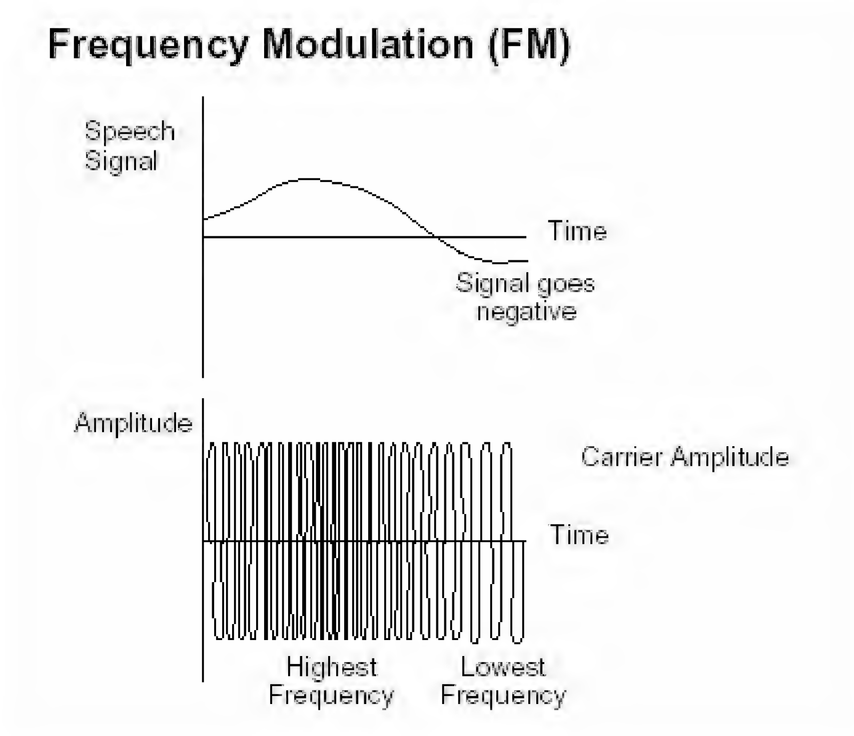
Fundamentals of Cellular Systems
Cell Basics



< 30 KHz	VLF
30 - 300 KHz	LF
300 KHz - 3 MHz	MF
3 - 30 MHz	HF
30 - 300 MHz	VHF
300 MHz - 3 GHz	UHF
3 - 30 GHz	SHF
> 30 GHz	EHF


Ionosphere
HF Transmission
Reflected
Absorption
Directional Antenna
VHF Transmission
Line of Sight
Reflected wave
interferes with signal


Amplitude Modulation (AM)
Speech
Signal
Time
Amplitude
Time
Replica of
Speech Signal
Carrier frequency
Carrier amplitude where
speech signal is zero
Time


Frequency Modulation (FM)
Speech Signal
Time
Signal goes negative
Amplitude
Carrier Amplitude
Time
Highest Frequency
Lowest Frequency

Theory/Exercise

Answer the following questions

1. Describe the short history of Cellular System?
2. Differentiate between Digital and Analog Mobile system?
3. Name five mobile phone models of first generation networks?
4. Name five mobile phone models of second generation networks?
5. Name five mobile phone models of third generation networks?
6. What is meant by GSM?
7. What is meant by AMP?
8. What is meant by CDMA?
9. What is difference between Waki talki and Telephone?
10. What are the main features being provided by modern Mobile phones?
11. What is the frequency upon Mobile phones operates in Pakistan?

Fill in the blank.

1. 1G - First Generation mobile phone networks were the ----------- cellular systems.
2. In 1G Mobiles signals were transmitted by the method of -----------------------.
3. In 1G, --------- frequency band was used for signals sending.
4. 1G Mobiles sent data from hand cell to --------------.
5. First 1G system to start operating in the USA in --------------.
6. The ------------------ of the network responsible for another feature of cell phone. communications.
7. NMT 450, the Nordic Mobile Telephone System was the first cell phone network to start operating in ---------------- in 1981.
8. One of the successful 2G digital systems is --------------GSM.
9. GSM standards were developed during the ---------------------1980s.
10. Commercial -----------were start operating in Europe in mid-1991.

Write True / False.

1. GSM system can operate any of the three frequency bands at 900, 1800 and 1900 MHz..
2. GSM phones can operate as dual- band or tri-band phones.
3. Frequency band of 890-915 MHz is dedicated to uplink communications from the mobile station to the base station.
4. Frequency Band of 935-960 MHz is used for the downlink communications from the base station to the mobile station.
5. 3G systems don't support higher data transmission rates.
6. 3G systems don't increased capacity.
7. We can access mobile Internet service and multimedia applications through 3G systems.
8. Third Generation systems use packet-switching technology.
9. The Third Generation mobile communication standard was a programm led originally by the ITU (International Telecommunications Union).
10. Cell phones don't provide an incredible array of functions.
11. Cell phones don't keep track of appointments and set remind.

Choose the write answer

1 We can access mobile Internet service and multimedia applications through

1G system	2G system	3G system	None

2 First country to introduce a 3G system

Japan	England	France	USA

3 Which technology is considered to be the superior transmission technology

CDMA	GSM	AMP	TDMA

4 Data rates supported by the basic 2G networks were only

9.6 kbs	15 kbs	20 kbs	5 kbs

5 In Pakistan , GSM is operating on frequency band of

500Mhz	1000MHz	900MHz	1800MHz

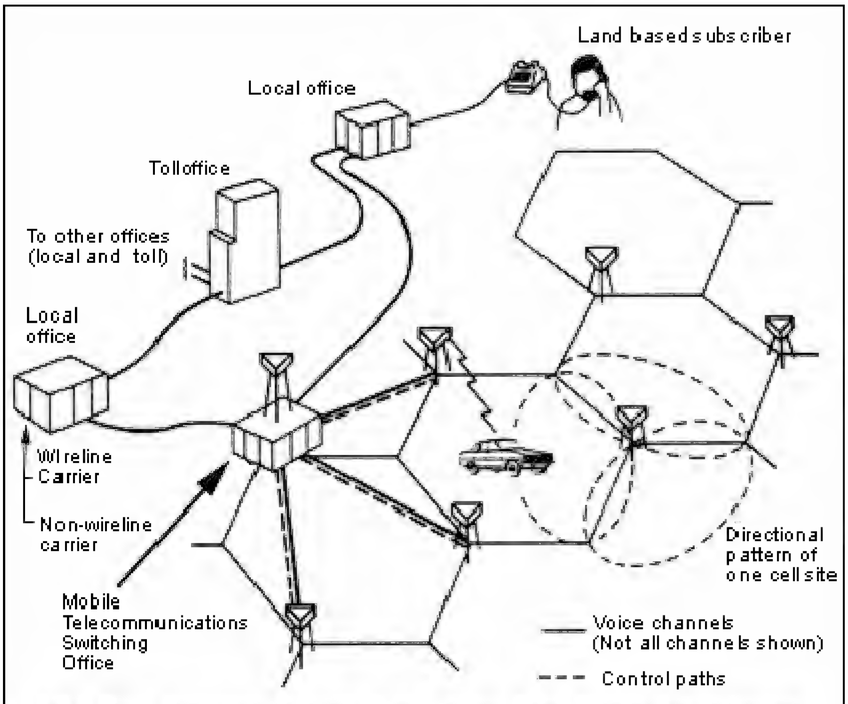
Practical Exercise-1

Topic: Make a comparative chart of 1G , 2G & 3G mobile system.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Mobile Communication Systems

Cellular System Infrastructure

Cellular radio provides mobile telephone service by employing a network of cell sites distributed over a wide area. A cell site contains a radio transceiver and a base station controller which manages, sends, and receives traffic from the mobiles in its geographical area to a cellular telephone switch. It also employs a tower and its antennas, and provides a link to the distant cellular switch called a mobile telecommunications switching office (MTSO). This MTSO places calls from land based telephones to wireless customers, switches calls between cells as mobiles travel across cell boundaries, and authenticates wireless customers before they make calls. Cellular uses a principle called frequency reuse to greatly increase customers served. Low powered mobiles and radio equipment at each cell site permit the same radio frequencies to be reused in different cells, multiplying calling capacity without creating interference. This spectrum efficient method contrasts sharply with earlier mobile systems that used a high powered, centrally located transmitter, to communicate with high powered car mounted mobiles on a small number of frequencies, channels which were then monopolized and not re-used over a wide area.



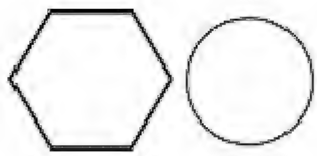
1984 Bell System Amps Plan, modified from the original

Cellular Frequency

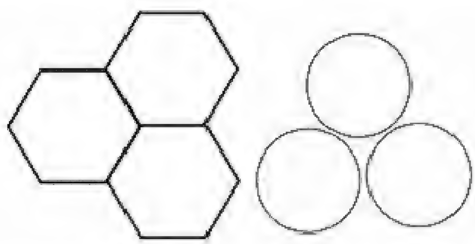
A single cell in an analog system uses one-seventh of the available duplex voice channels. That is, each cell (of the seven on a hexagonal grid) is using one-seventh of the available channels so it has a unique set of frequencies and there are no collisions:
A cell-phone carrier typically gets **832 radio frequencies** to use in a city.
Each cell phone uses two frequencies per call -- a duplex channel -- so there are typically **395 voice channels** per carrier. (The other 42 frequencies are used for control channels)
Therefore, each cell has about **56 voice channels** available.
In other words, in any cell, 56 people can be talking on their cell phone at one time. With digital transmission methods, the number of available channels increases. For example, a **TDMA-based** digital system can carry three times as many calls as an analog system, so each cell has about 168 channels available (see this page for lots more information on TDMA, CDMA, GSM and other digital cell-phone techniques).

Cell / Sector terminology

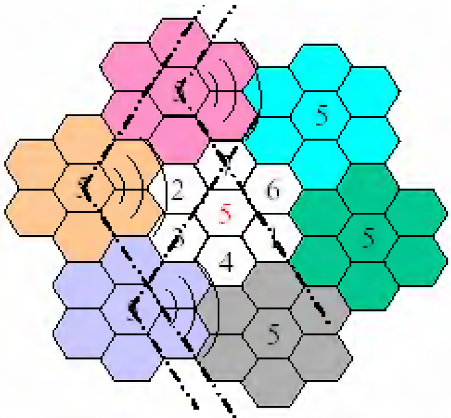
With cellular radio we use a simple hexagon to represent a complex object: the geographical area covered by cellular radio antennas. These areas are called cells. Using this shape let us picture the cellular idea, because on a map it only approximates the covered area. Why a hexagon and not a circle to represent cells?



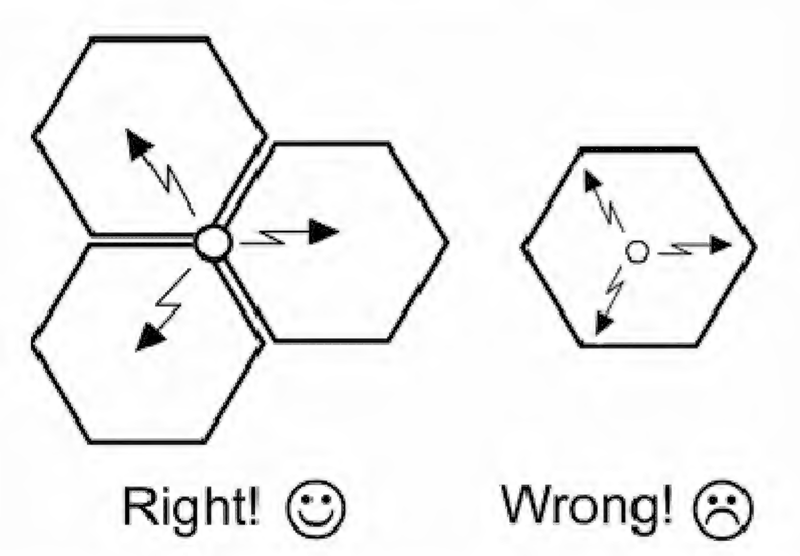
When showing a cellular system we want to depict an area totally covered by radio, without any gaps. Any cellular system will have gaps in coverage, but the hexagonal shape lets us more neatly visualize, in theory, how the system is laid out. Notice how the circles below would leave gaps in our layout. Still, why hexagons and not triangles or rhomboids? Read the text below and we'll come to that discussion in just a bit.



Notice the illustration below. The middle circles represent cell sites. This is where the base station radio equipment and their antennas are located. A cell site gives radio coverage to a cell. Do you understand the difference between these two terms? The cell site is a location or a point, the cell is a wide geographical area.

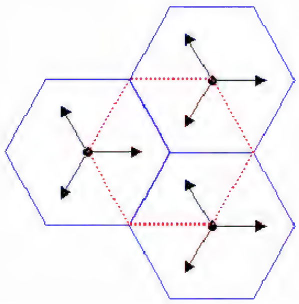


Most cells have been split into sectors or individual areas to make them more efficient and to let them to carry more calls. Antennas transmit inward to each cell. That's very important to remember. They cover a portion or a sector of each cell, not the whole thing. Antennas from other cell sites cover the other portions. The covered area, if you look closely, resembles a sort of rhomboid, as you'll see in the diagram after this one. The cell site equipment provides each sector with its own set of channels. In this example, just below, the cell site transmits and receives on three different sets of channels, one for each part or sector of the three cells it covers.



If you understand cells and sectors or come back if you get hung Reserved up on the terms at some later point. For most of us, let's go through this again, this time from

another point of view. Mark provides the diagram and makes some key points here: "Most people see the cell as the blue hexagon, being defined by the tower in the center, with the antennae pointing in the directions indicated by the arrows. In reality, the cell is the red hexagon, with the towers at the corners, as you depict it above and I illustrate it below. The confusion comes from not realizing that a cell is a geographic area, not a point. We use the terms 'cell' (the coverage area) and 'cell site' (the base station location) interchangeably, but they are not the same thing." Mark goes on to talk about cells and sectors and the kind of antennas needed: "These days most cells are divided into sectors.



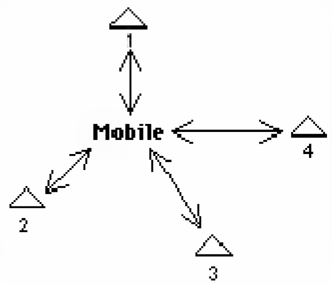
Typically three but you might see just two or rarely six. Six sectored sites have been touted as a Great Thing by manufacturers such as Hughes and Motorola who want to sell you more equipment. In practice six sectors sites have been more trouble than they're worth. So, typically, you have three antennas per sector or 'face'. You'll have one antenna for the voice transmit channel, one antenna for the set up or control channel, and two antennas to receive. Or you may duplex one of the transmits onto a receive. By sect raising you gain better control of interference issues. That is, you're transmitting in one direction instead of broadcasting all around, like with an omni directional antenna, so you can tighten up your frequency re use"





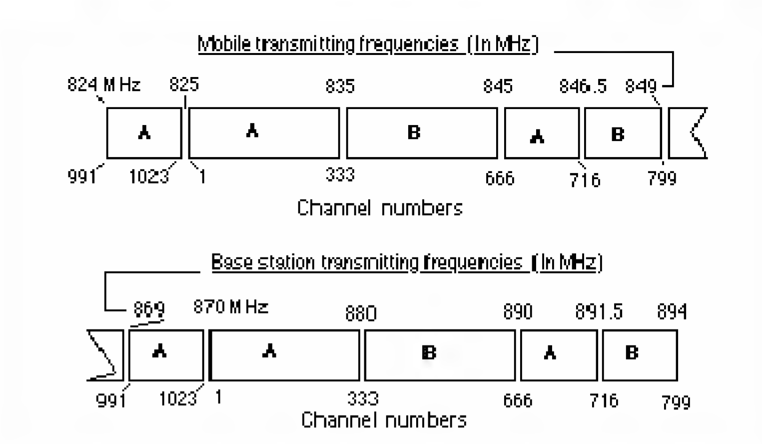
Cell Phone Theory and Operation

Cell phone theory is simple. Executing that theory is extremely complicated. Each cell site has a base station with a computerized 800 or 1900 megahertz transceiver and an antenna. This radio equipment provides coverage for an area that's usually two to ten miles in radius. Even smaller cell sites cover tunnels, subways and specific roadways.



The area size depends on, among other things, topography, population, and traffic. When you turn on your phone the mobile switch determines what cell will carry the call and assigns a Vacant radio channel within that cell to take the conversation. It selects the cell to serve you by measuring signal strength, matching your mobile to the cell that has picked up the strongest signal. Managing handoffs or handovers, that is, moving from cell to cell is handled in a similar manner. The base station serving your call sends a hand-off request to the mobile switch after your signal drops below a handover threshold. The cell site makes several scans to confirm this and then switches your call to the next cell. You may drive fifty miles, use 8 different cells and never once realize that your call has been transferred. At least, that is the goal. Let's look at some details of this amazing technology, starting with cellular place in the radio spectrum and how it began. The FAA (frequency allocation authority) in the Pakistan for commercial and amateur radio services. Some of these assignments may be coordinated with the International Telecommunications Union but many are not. Much debate and discussion over many years placed cellular frequencies in the 800 megahertz band. By comparison, PCS or Personal Communication Services technology, still cellular radio, operates in the 1900 MHz band. The FAA with PTA also issues the necessary operating licenses to the different cellular providers. The Pakistan government decided to issue license to more carriers. One license went to telecome the other went to a company warid And, perhaps most importantly, who won the cellular lottery. Since there were so many qualified applicants, operating licenses were ultimately granted by open bidding, not by a spectrum auction as they are today. The local telephone companies were called the wire line carriers. The others were the non-wire line carriers. Each company in each area took half the spectrum available. What's called the "A Band" and the "B Band." The nonwireline carriers usually got the A Band and the wire line carriers got the B band. There's no

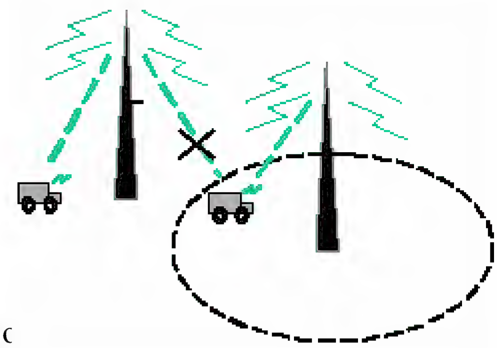
real advantage to having either one. It's important to remember, though, that depending on the technology used, one carrier might provide more connections than a competitor does with the same amount of spectrum. [See A Band, B Band]



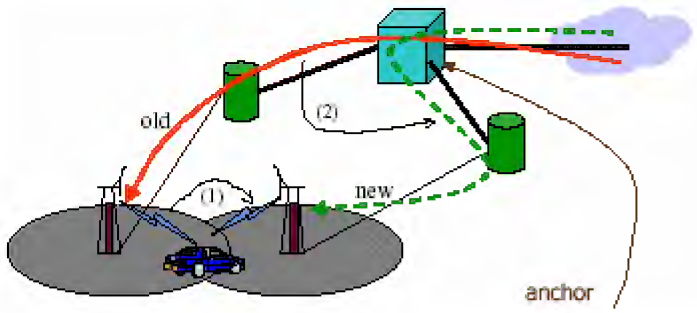
Mobiles transmit on certain frequencies, cellular base stations transmit on others. A and B refer to the carrier each frequency assignment has. A channel is made up of two frequencies, one to transmit on and one to receive.

Handoff and central control

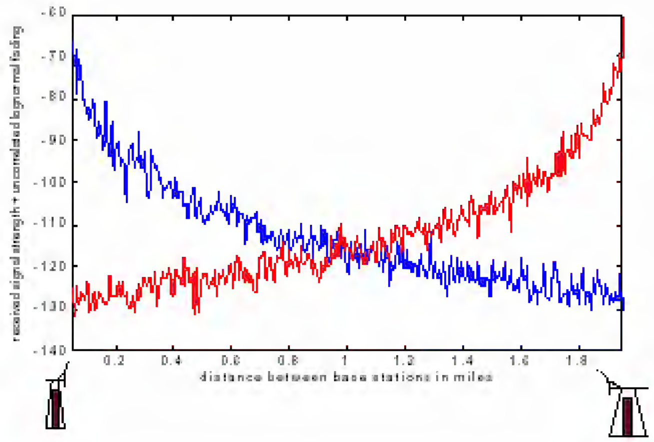
- Cellular architecture requires handoffs for call in progress
- Radio Mobility
- Techniques used based on air interface standard
- Traditional method: Hard Handoff
- Soft Handoff possible in CDMA systems



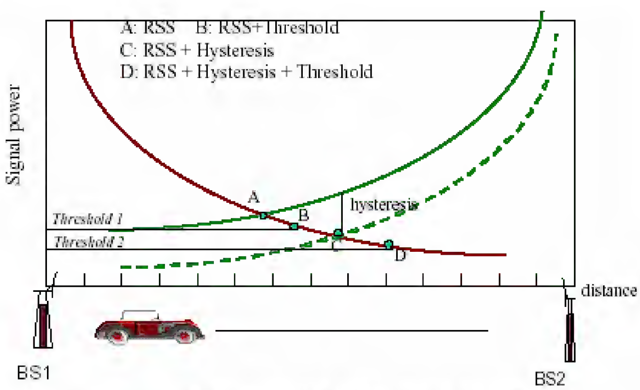
- Handoff measurement: majc
- Identify the need
- Identify the candidate
- Evaluate the candidates
- Select a target cell
- Note Need to reroute connection in wired network.
- Point



Sample RSS from two base stations as seen by a MS traveling in a straight line between them



Handoff Decision

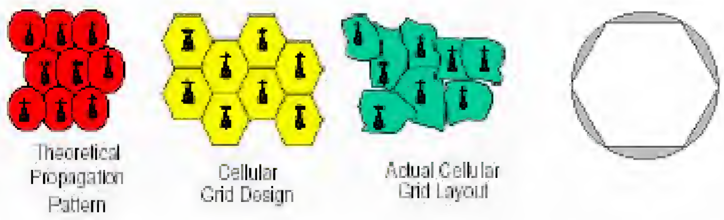


Traditional handoff algorithms using RSS thresholds and hysteresis

Cellular geometry and system design

Propagation models represent cell as a circular area.

Approximate cell coverage with a hexagon - allows easier analysis.
Frequency assignment of F MHz for the system.
The multiple access techniques translates F to T traffic channels.
Cluster of cells K = group of adjacent cells which use all of the systems frequency assignment



Why not a large radio tower and large service area?
Number of simultaneous users would be very limited (to total number of traffic channels T)
Mobile handset would have greater power requirement and small cells with frequency reuse

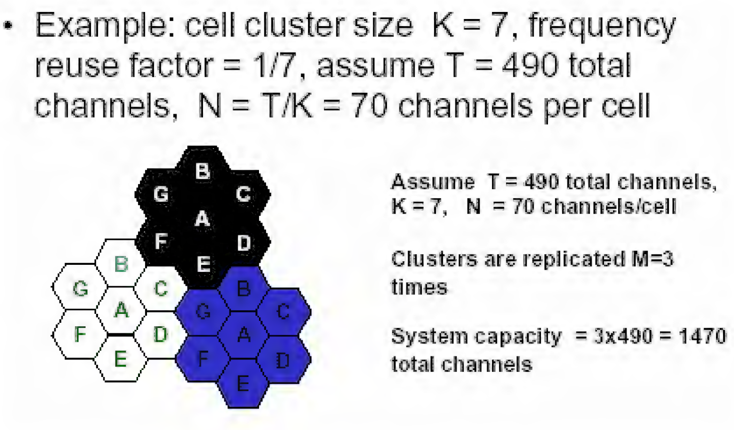
Advantages

Lower power handsets
Increases system capacity with frequency reuse

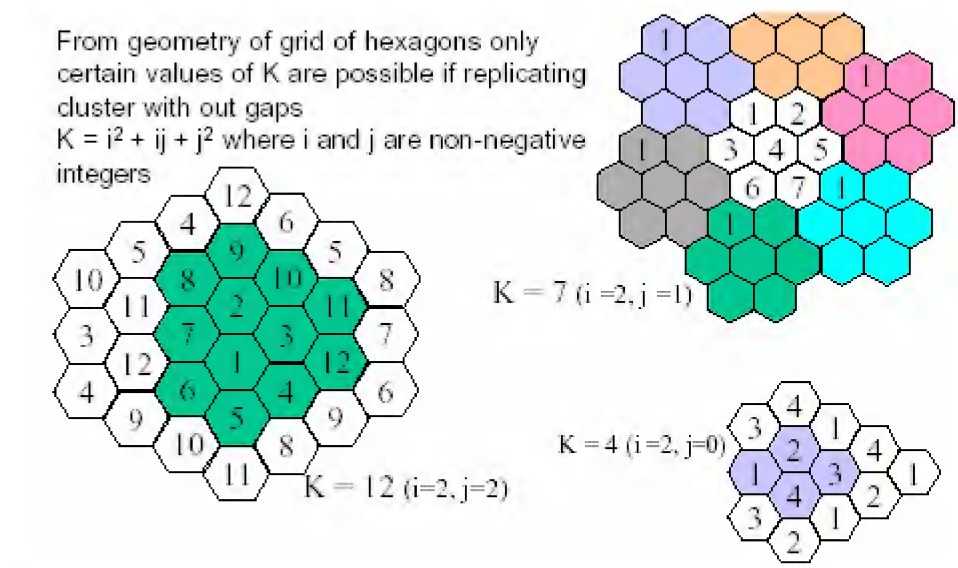
Drawbacks:

Cost of cells
Handoffs between cells must be supported
Need to track user to route incoming call/message
Let T = total number of duplex channels
K cells = size of cell cluster (typically 4, 7, 12, 21)
N = T/K = number of channels per cell
For a specific geographic area, if clusters are
replicated M times, then total number of channels system capacity = M x T
Choice of K determines distance between cells using the same frequencies – termed co-channel cells

Cell design Rules.



Cluster Size



Transmission

Cell phones have low-power transmitters in them. Many cell phones have two signal strengths: 0.6 watts and 3 watts (for comparison, most CB radios transmit at 4 watts). The base station is also transmitting at low power. Low-power transmitters have two advantages:

The transmissions of a base station and the phones within its cell do not make it very far outside that cell. Therefore, in the figure above, both of the purple cells can reuse the same 56 frequencies. The same frequencies can be reused extensively across the city.

The power consumption of the cell phone, which is normally battery-operated, is relatively low. Low power means small batteries, and this is what has made handheld cellular phones possible.

The cellular approach requires a large number of base stations in a city of any size. A typical large city can have hundreds of towers. But because so many people are using cell phones, costs remain low per user. Each carrier in each city also runs one central office called the Mobile Telephone Switching Office (MTSO). This office handles all of the phone connections to the normal land-based phone system, and controls all of the base stations in the region.

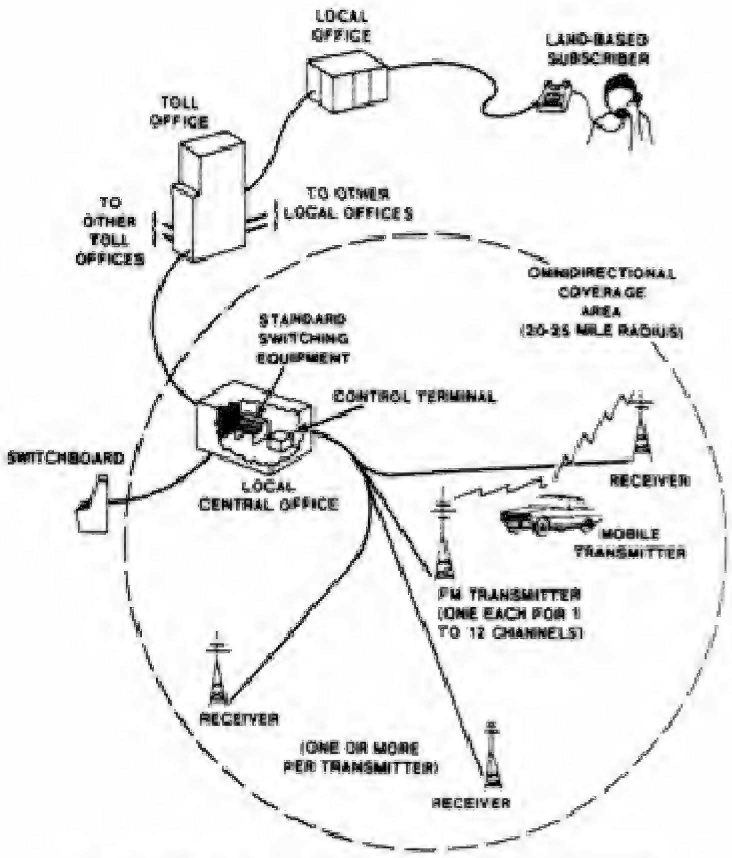


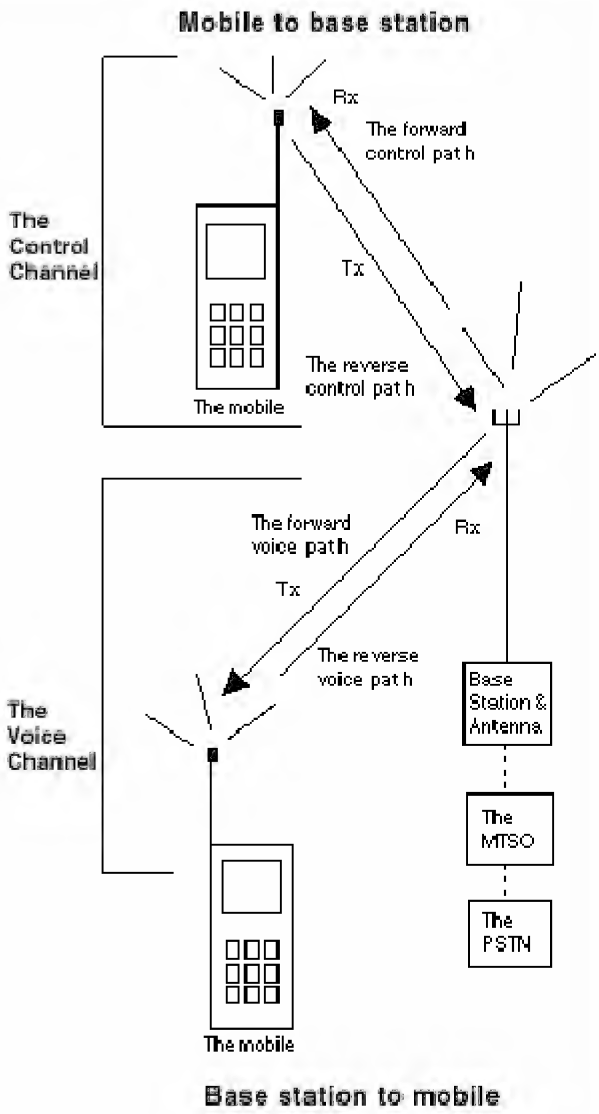
Figure 11-34. A manual, or MJ/MK, mobile telephone system.

Channels

Channel Names and Functions

The first point is that cell phones and base stations transmit or communicate with each other on dedicated paired frequencies called channels. Base stations use one frequency of that channel and mobiles use the other. Got it? The second point is that a certain amount of bandwidth called an offset separates these frequencies. Now let's look at what these frequencies do, as we discuss how channels work and how they are used to pass information back and forth. Certain channels carry only cellular system

data. We call these control channels. This control channel is usually the first channel in each cell. It's responsible for call setup, in fact, many radio engineers prefer calling it the setup channel since that's what it does. Voice channels, by comparison, are those paired frequencies which handle a call's traffic, be it voice or data, as well as signaling information about the call itself. A cell or sector's first channel is always the control or setup channel for each cell. You have 21 control channels if you have 21 cells. A call gets going, in other words, on the control channel first and then drops out of the picture once the call gets assigned a voice channel. The voice channel then handles the conversation as well as further signaling between the mobile and the base station. Don't place too much importance, by-the-way, to the setup Aslan Technologies channel. Although first in each cell's lineup, most radio engineers place priority on the voice channels in a system. The control channel lurks in the background. When discussing cell phone operation we call a base station's transmitting frequency the forward path. The cell phone's transmitting frequency, by comparison, is called the reverse path. Do not become confused. Both radio frequencies make up a channel as we've discussed before but we now treat them individually to discuss what direction information or traffic flows. Knowing what direction is important for later, when we discuss how calls are originated and how they are handled. Once the MTSO or mobile telephone switch assigns a voice channel the two frequencies making up the voice channel handle signaling during the actual conversation. You might note then that a call two channels: voice and data. Got it? Knowing this makes many things easier. A mobile's electronic serial number is only transmitted on the reverse control channel. A person tracking ESNs need only monitor one of 21 frequencies. They don't have to look through the entire band. So, we have two channels for every call with four frequencies involved. Clear? And a forward and reverse path for each frequency. Let's name them here. Again, a frequency is the medium upon which information travels. A path is the direction the information flows. Here you go:
--> Forward control path: Base station to mobile
<-- Reverse control path: Mobile to base station
--> Forward voice path: Base station to mobile
<-- Reverse voice path: Mobile to base station
One last point at the risk of losing everybody. You'll hear about dedicated control channels, paging channels, and access channels. These are not different channels but different uses of the control channel. Let's clear up this terminology confusion by looking at call processing. We'll look at the way AMPS sets up calls. Both analog and digital cellular (IS-136) use this method, CDMA cellular (IS-95) and GSM being the exceptions. We'll also touch on a number of new terms along the way. Still confused about the terms channels, frequency, and path? and how they relate to each other?



The control channel and the voice channel, paired frequencies upon which information flows. Paths indicate flow direction.

[Control channel] "Is the control channel important? Actually, I can't think of a case where it would not be. But we don't think of it that way in the business. We have a set-up channel and we have voice channels. They are so different (both in function and in how they are managed) that we never think of the set-up channel as the first of the cell's channels -- it's in a class by itself. If you ask an engineer in an AMPS system what channels he has on a cell, he'll automatically give you the voice channels. Set up channel is a separate question. Just a matter of mindset. You might add channels, re-tune partially or completely, and never give a thought to the set-up channel. If asked how many channels are on a given cell, you'd never think to include the set-up channel in the count." Mark van deer Hook. Personal correspondence. Channels,

frequencies, and paths: Cellular radio employs an arcane and difficult terminology; many terms apply to all of wireless, many do not. When discussing cellular radio, which comprises analog cellular, digital cellular, and PCS, frequency is a single unit whereas channel means a pair of frequencies, one to transmit on and one to receive. (See the diagram above.) The terms are not interchangeable although many writers use them that way. Frequencies are measured or numbered by their order in the radio spectrum, in Hertz, but channels are numbered by their place in a particular radio plan. Thus, in cell #1 of 21 in a cellular carrier's system, the frequencies may be 879.990 Hz for transmitting and 834.990 Hz for receiving. These then make up Channel 1 in that cell, number 333 overall. Again, in cellular, a channel is a pair of frequencies. The frequencies are described in Hz, the channels by numbers in a plan. Now, what about path? Path, channel, and frequency, depending on how they are used in wireless working, all constitute a communication link. In cellular, however, path does not, or should not, describe a transmission link, but rather the direction in which information flows. The forward path denotes information flowing from the base station to the mobile. The reverse path describes information flowing from the mobile to the base station. With frequency and channel we talk about the physical medium which carries a signal, with path we discuss the direction a signal is going on that medium. Is this clear?

Call Organization Process

This is AMPS call processing for analog and digital services, CDMA or IS-95 excluded. There are two parts to this diagram, click on the links below to see the readable images

Getting Call Process

Okay, your phone's now registered with your local system. Let's say you get a call. It's the F.B.I., asking you to turn yourself in. You laugh and hang up. As you speed to Mexico you marvel at the technology involved. What happened? Your phone recognized its mobile number on the paging channel. Remember, that's always the forward control channel or path except in a CDMA system. The mobile responded by sending its identifying information again to the MTSO, along with a message confirming that it received the page. The system responded by sending a voice channel assignment to the cell you were in. The cell site's transceiver got this information and began setting things up. It first informed the mobile about the new channel, say, channel 10 in cell number 8. It then generated a supervisory audio tone or SAT on the forward voice frequency.

The SAT, Dial Tone, and Blank and Burst

[Remember that we are discussing the original or default call set up routine in AMPS. IS-136 and IS-95 use a different, all digital method, although they switch back to this basic version we are now describing in non-digital territory. GSM also uses a different, incompatible technique to set up calls.] An SAT is a high pitched, inaudible tone that helps the system distinguish between callers on the same channel but in different cells. The mobile tunes to its assigned channel and it looks for the right supervisory audio tone. Upon hearing it, the mobile throws the tone back to the cell site on its reverse voice channel. What engineers call transponder, the automatic relaying of a signal? We now have a loop going between the cell site and the phone. No SAT or the wrong SAT means no good. An AMP generates the supervisory audio tone at three different non-radio frequencies. SAT 0 is at 5970 Hz, SAT 1 is at6000 Hz, and SAT 2 is at 6030 Hz. using different frequencies makes sure that the mobile is using the right channel assignment. It's not enough to get a tone on the right forward and reverse path -- the mobile must connect to the right channel and the right SAT. Two steps. This tone is transmitted continuously during a call. You don't hear it since it's filtered during transmission. The mobile, in fact, drops a call after five seconds if it loses or has the wrong the SAT. The all digital GSM and PCS systems, by comparison, drops the call like AMPS but then automatically tries to re-connect on another channel that may not be suffering the same interference.

The cell site unmutes the forward voice channel if the SAT gets returned, causing the mobile to take the mute off the reverse voice channel. Your phone then produces a ring for you to hear. This is unlike a landline telephone in which ringing gets produced at a central office or switch. To digress briefly, dial tone is not present on AMPS phones, although E.F. Johnson phones produced land line type dial tone within the unit.

Enough about the SAT. I mentioned another tone that's generated by the mobile phone itself. It's called the signaling tone or ST. Don't confuses it with the SAT. You need the supervisory audio tone first. The ST comes in after that; it's necessary to complete the call. The mobile produces the ST, compared to the SAT which the cell site originates. It's a 10 kHz audio tone. The mobile starts transmitting this signal back to the cell on the forward voice path once it gets an alerting message. Your phone stops transmitting it once you pick up the handset or otherwise goes off hook to answer the ring. Cell folks might call this confirmation of alert. The system knows that you've picked up the phone when the ST stops. AMPS use signaling tones of different lengths to indicate three other things. Clear down or termination means hanging up, going on hook, or terminating a call. The phone sends a signaling tone of 1.8 seconds when that happens. 400 ms. of ST means a hook flash. Hook flash requests additional

services during a conversation in some areas. Confirmation of. Handover request is another arcane cell term. The ST gets sent for 50 ms. before your call is handed from one cell to another. Along with the SAT. That assures a smooth handoff from one cell to another. The MTSO assigns a new channel, checks for the right SAT and listens for a signaling tone when a handover occurs. Complicated but effective and all happening inless than a second.

We're now on the line with someone. Maybe you! How does the mobile communicate with the base station, now that a conversation is in progress? Yes, there is a control frequency but the mobile can only transmit on one frequency at a time. So what happens? The secret is a straightforward process known as blank and burst. "Once a call is up on a voice channel, all signaling is done on the voice channel via a scheme known as "Blank and Burst". When the site needs to send an order to the mobile, such as hand off, power up, or power down, it mutes the SAT on the voice channel. This is filtered at the mobile so that the customer never hears it. When the SAT is muted, the phone mutes the audio path, thus the "blank", and the site sends a "burst" of data. The process takes a fraction of a second and is scarcely noticeable to the customer. Again, it's more noticeable on a Motorola system than on Ericsson or Lucent. You can sometimes hear the 'bzzt' of the data burst." Blank and burst is similar to the way many telco payphones signal. Let's say you're making a long distance call. The operator or the automated coin toll service computer asks you for money for the first three minutes. The payphone will mute or blank out the voice channel when you deposit the coins. That's so it can burst the tones of the different denominations to the operator or ACTS. These days you won't often hear those tones. And all done through blank and burst. Now let's get back to cellular.

Making a Call process

Origination -- Making a call

Making a mobile call uses many steps that help receive a call. The same basic process. Punch out the number that you want to call. Press the send button. Your mobile transmits that telephone number, along with a request for service signal, and all the information used to register a call to the cell site. The mobile transmits this information on the strongest reverse control channel. The MTSO checks out this info and assigns a voice channel. It communicates that assignment to the mobile on the forward control channel. The cell site opens a voice channel and transmits a SAT on it. The mobile detects the SAT and locks on, transmitting it back to the cell site. The MTSO detects this confirmation and sends the mobile a message in return. This could be several things. It might be a busy signal, ringback or whatever tone was delivered to the switch. Making a call, however, involves far more problems and resources than

an incoming call does. Making a call and getting a call from your cellular phone should be equally easy. It isn't, but not for technical reasons, that is setting up and carrying a call. Rather, originating a call from a mobile presents fraud issues for the user and the carrier. Especially when you are out of your local area. Incoming calls don't present a risk to the carrier. Someone on the other end is paying for them. The carrier, however, is responsible for the cost of fraudulent calls originating in its system. Most systems shut down roaming or do an operator intercept rather than allow a questionable call. I've had close friends asked for their credit card numbers by operators to place a call.

Can you imagine giving a credit card number or a calling card number over the air? You're now making calls at a payphone, just like the good old days. Cellular One has shut down roaming "privileges" altogether in New York City, Washington and Miami at different times. But you can go through their operator and pay three times the cost of a normal call if you like. So what's going on? Why the problem with some outgoing calls? We first have to look at some more terms and procedures. We need to see what happens with call processing at the switch and network level. This is the exciting world of precall validation.

[Dial tone] During the start of your call a "No Service" lamp or display instead tells you if coverage isn't available If coverage is available you punch in your numbers and get a response back from the system. Imagine dialing your landline phone without taking the receiver of the hook. If you could dial like that, where would be the for dial tone?

[Much more on the SAT and co-channel

interference] The supervisory audio tone distinguishes between co-channel interferrors, an intimidatingly named but important to know problem in cellular radio. Co-channel interferers are cellular customers using the same channel set in different cells who unknowingly interfere with each other. We know all about frequency reuse and that radio engineers carefully assign channels in each cell to minimize interference. But what happens when they do? Let's see how AMPS uses the SAT in practice and how it handles the interference problem. Two people, a businessman using his cell phone in the city, and a hiker on top of a mountain overlooking the city. The businessman's call is going well. But now the hiker decides to use his phone to tell his.friends he has climbed the summit. (Or as we American climbers say, "bagged the peak.") From the climber's position he can see all of the city and consequently the entire area under cellular coverage. Since radio waves travel in nearly a straight line at high frequencies, it's possible his call could be taken by nearly any cell. Like the one the businessman is now using. This is not what radio engineers plan on, since the nearest cell site usually handles a call, in fact, Mark points out they don't want people using cell phones on an airplane! "Knock it off, turkey! Can't you see you're confusing the poor cell sites?" If the hiker's mobile is told by the cell site first setting up his call

to go channel 656, SAT 0, but his radio tunes now to a different cell with channel 656, SAT 1, instead, a fade timer in the mobile shuts down its transmitter after five seconds. In that way an existing call in the cell is not disrupted. If the mobile gets the right channel and SAT but in a different cell than intended, FM capture occurs, where the stronger call on the frequency will displace, at least temporarily, the weaker call. Both callers now hear each other's conversation. A multiple SAT condition is the same as no SAT, so the fade timer starts on both calls. If the correct SAT does not resume before the fade timer expires, both calls are terminated Mark puts it simply, "Remember, the only thing a mobile can do with SAT is detect it and transpond it. Either it gets what it was told to expect, and transponds it, or it doesn't get what it was told to expect, in which case it starts the fade timer. If the fade timer expires, the mobile's transmitter is shut down and the call is over."

[SIT] "A large supplier and a carrier I worked for went round and round on this. If their system did not detect hand-off confirmation, it.tore down the call. Even if it got to the next site successfully. Their reasoning was that, if the mobile was in such a poor radio frequency environment that 50 ms of ST could not be detected, the call is in bad shape and should be torn down. We disagreed. We said, "Let the customer decide. If it's a lousy call, they'll hang up. If it's a good call, we want it to stay up!" Just because a mobile on channel 423 is in trouble doesn't mean that it will be when it hands off to channel 742 in another cell! In fact, a hand-off may happen just in time to save a call that is going south. Why?" "Well, just because there is interference on channel 423 doesn't mean that there is on 742! Or what if the hand-off dragged? That is, for whatever reason the call did not hand off at approximately half way between the cells. (Lot's of reasons that could happen.) So the path to the serving site is stretched thiiiiin, almost to the point of dropping the call. But the hand-off, almost by definition in this case, will be to a site that is very close. That ought to be a good thing, you'd think. Well, the system supplier predicted Gloom, Doom, and Massive Dropped Calls if we changed it. We insisted, and things worked much better. Hand-off failures and dropped calls did not increase, and perceived service was much better. For this and a number of other reasons I have long suspected that their system did not do a good job of detecting ST . . ."

[Clone comments] "You could make more clear that this is due to validation and fraud issues, not to the mechanics of setting up the call, since this is pretty much the same for originations and terminations." "By the way, at AirTouch we took a big bite out of fraudulent calls when we stopped automatically giving every customer international dialing capability. We gave it to any legitimate customer who asked for it, but the default was no international dialing. So the cloners would rarely get a MIN/ESN combo that would allow them to make calls to Colombia to.make those 'arrangements'. Yes, the drug traffic was a huge part of the cloning problem. We had some folks who worked a lot with law enforcement, particularly the DEA. Another

large part of it was the creeps who would sell calls to South America on the street corners of L.A. Illegal immigrants would line up to make calls home on this cloned phone." "Actually, even though it's an inconvenience, being cloned can be fun if you are an engineer working for the carrier. You can do all kinds of fun things with the cloner. Like seeing where they are making their calls and informing the police. Like hotlining the phone so that ALL calls go straight to customer service. It would have been fun to hotline them to INS, but INS wouldn't have liked that.

Registration

A mobile phone runs a self diagnostic when it's powered up. Once completed it acts like a scanning radio. Searching through its list of forward control channels, it picks one with the strongest signal, the nearest cell or sector usually providing that. Just to be sure, the mobile re-scans and camps on the strongest one. Not making a call but still on? The mobile re-scans every seven seconds or when signal strength drops before a pre-determined level. Next, as Will Galloway writes, "After an AMPS phone selects the strongest channel, it tries to decode the data stream and in particular the System ID, to see if it's at home or roaming. If there are too many errors, it will switch to the next strongest channel. It also watches the busy/idle bit in the data stream to find a free slot to transmit its information." After selecting a channel the phone then identifies itself on the reverse control path. The mobile sends its phone number, its electronic serial number, and its home system ID. Among other things. The cell site relays this information to the mobile telecommunications switching office. The MTSO, in turn, communicates with different databases, switching centers and. software programs.

The local system registers the phone if everything checks out. Mr. Mobile can now take incoming calls since the system is aware that it is in use. The mobile then monitors paging channels while it idles. It starts this scanning with the initial paging channel or IPCH. That's usually channel 333 for the non-wireline carrier and 334 for the wireline carrier. The mobile is programed with this information and 21 channels to scan when your carrier programs your phone's directory number, the MIN, or mobile identification number. Again, the paging channel or path is another word for the forward control channel. It carries data and is transmitted by the cell site. A mobile first responds to a page on the reverse control channel of the cell it is in. The MTSO then assigns yet another channel for the conversation. But I am getting ahead of myself. Let's finish registration.

Registration is an ongoing process. Moving from one service area to another causes registration to begin again. Just waiting ten or fifteen minutes does the same thing. It's an automatic activity of the system. It updates the status of the waiting phone to let the system know what's going on. The cell site can initiate registration on its own by

sending asignal to the mobile. That forces the unit to transmit and identify itself. Registration also takes place just before you call. Again, the whole process takes only a few hundred milliseconds. AMPS, the older, analog voice system, not the digital IS-136, uses frequency shift keying to send data. Just like a modem. Data's sent in binary. 0's and 1's. 0's go on one frequency and 1's go on another. They alternate back and forth in rapid succession. Don't be confused by the mention of additional frequencies. Frequency shift keying uses the existing carrier wave. The data rides 8kHz above and below, say, 879.990 MHz. Read up on the earliest kinds of modems and FSK and you'll understand the way AMPS sends digital information. Data gets sent at 10 kbps or 10,000 bits per second from the cell site. That's fairly slow but fast enough to do the job. Since cellular uses radio waves to communicate signals are subject to the vagaries of the radio band. Things such as billboards, trucks, and underpasses, what Lee calls local scatters, can deflect a cellular call. So the system repeats each part of each digital message five times. That slows things considerably. Add in the time for encoding and decoding the digital stream and the actual transfer rate can fall to as low as 1200 bps.

Roaming

If the SID on the control channel does not match the SID programmed into your phone, then the phone knows it is roaming. The MTSO of the cell that you are roaming in contacts the MTSO of your home system, which then checks its database to confirm that the SID of the phone you are using is valid. Your home system verifies your phone to the local MTSO, which then tracks your phone as you move through its cells. And the amazing thing is that all of this happens within seconds!

Theory Exercise

Answer the following questions

1. What is Cellular Frequencies for various networks?
2. What is Cell Technology?
3. Who Cell Phone Works?
4. Define Cell Splitting?
5. What is the function of a channel? Name various channels used in various cellular systems?
6. What is Registration?
7. Define roaming and how it is important?
8. What is transmission? What are the most common transmission techniques used in cellular technology?
9. What is GSM technology?
10. What is handoff control?

Fill in the blank.

1. Cellular uses a principle called ------------------to greatly increase customers served
2. A single cell in an analog system uses one-seventh of the available -------------channels.
3. A cell-phone carrier typically gets --------------------to use in a city
4. The geographical area covered by cellular radio antennas. These areas are called ----------------.
5. Each cell site has a base station with a computerized --------------megahertz transceiver and an antenna
6. The **---------------**of the cell phone, which is normally battery-operated, is relatively low.
7. Each carrier in each city also runs one central office called the **----------------------**
8. Radio channels can be used reliably to communicate at distances of only about ----------------
9. ---------------------- means hanging up, going on hook, or terminating a call.
10. If the SID on the control channel does not match the SID programmed into your phone, then the phone knows it is **--------------------**

Write True / False

1. A cell has about **56 voice channels** available
2. **TDMA-based** digital system can carry ten times as many calls as an analog system
3. Antennas transmit outward to each cell
4. The non wire line carriers usually got the A Band

5. The wire line carriers got the B band.
6. Cellular architecture requires handoffs for call in progress
7. The backward path denotes information flowing from the base station to the mobile
8. An SAT is a high pitched, inaudible tone that helps the system distinguish between callers on the same channel but in different cells
9. AMPS generates the supervisory audio tone at three different non-radio frequencies
10. The mobile, in fact, drops a call after five seconds if it loses or has the wrong the SAT

Choose the right answer

GSM is the digital standard for Europe; What do the letters GSM currently mean?

1. Global Special Mobile
2. Greater System's Mobile
3. Global Systems for Mobile Communications
4. none of the above!

Why is a digital network preferred over an analogue one?

1. It is newer
2. It is smaller
3. It has lower power consumption
4. It has higher capacity for the same bandwidth

The (or one of the) difference(s) between GSM and PCN is :

1. GSM operates in the frequency range of 900MHz while PCN operates in the 1800MHz range
2. GSM is the standard used in Europe, while PCN is the one in North America
3. GSM uses digital technology while PCN is analogue
4. none! There is no difference

Which of the four cellular networks in the UK is the best and why?

1. Mercury, because it offers good service within its covered area.
2. Orange, because of its good "inside building" coverage.
3. Vodafone, because it uses GSM
4. Cellnet , because it offers a wider range of phones-sets

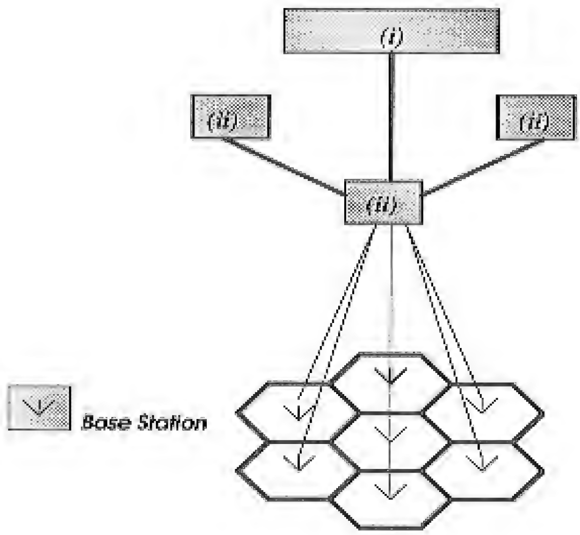
On the surface, queuing of handover requests seems to be a bad scheme and not possible since handover must not be noticed(delay sensitive) by the user. But it turns

out that queuing handover request is possible.
Why is handover request queuing possible?

1. Handover request taking up to 800ms would not be noticed by the user. Queuing is possible within this time.
2. There exist a time interval between the mobile phone reaching the handover threshold and the receiver threshold.
3. Handover request can be made small packets. Therefore the queue can be processed very quickly.
4. The alternative to queuing handover request is queuing new originating calls which is far more delay sensitive. Therefore queuing handover request(although delay sensitive) is a better idea.

Practical Exercise-1

Topic: Explain with the help of a diagram the structure of a cellular network. Instructor to explain the working of network referring to diagram shown.	Date:



What is (i) and (ii)?

A. Mobile phone and Mobile Switching Centre(MSC)

B. Public Switched Telephone Network(PSTN) and Mobile Switching Centre(MSC)

C. Mobile Switching Centre(MSC) and Public Switched Telephone Network(PSTN)

D. None of the above

<u>Findings</u>

Trainee Signature
Instructor's Remarks
Instructor's Signature

Practical Exercise-2

Topic: The instructor will take the class to cellular phone company head office or regional office and explain the working of cells at computer system.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

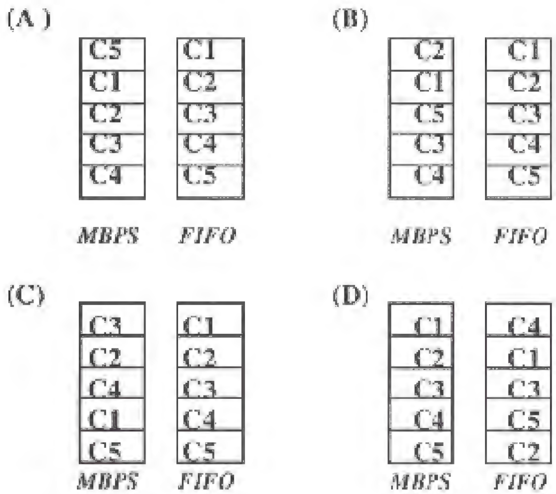
Practical Exercise-3

Topic: There are five cars(C1, C2, C3, C4 and C5) moving away from cell A into cell B. The table below shows the time at which each car arrives at the handover threshold and the speed at which they are traveling	Date:

Car	Arrival time(ms)	Speed(km/h)
C1	0	10
C2	10	40
C3	15	50
C4	25	20
C5	100	360

There are several assumption that the candidate is allowed to make about this question. They are :-

- All the cars are travelling away from the handover threshold towards the receiver threshold.
- none of the cars have reached the receiver threshold at 100ms.
- the handover area is divided into infinite power level ratios.
- The choices below shows the possible arrangement of the FIFO queue and the MBPS queue of the handover requests at 100ms. C1, C2, C3, C4 and C5 represent the handover requests made by the mobile phones from the cars of the same name. Choose the correctly arranged queue.



Findings

Trainee Signature
Instructor’s Remarks
Instructor’s Signature

Practical Exercise-4

Topic: Instructor will take the trainee to the site and will observe the change when a cell phone moves from one cell to another.	Date:
<u>Findings</u>	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Practical Exercise-5

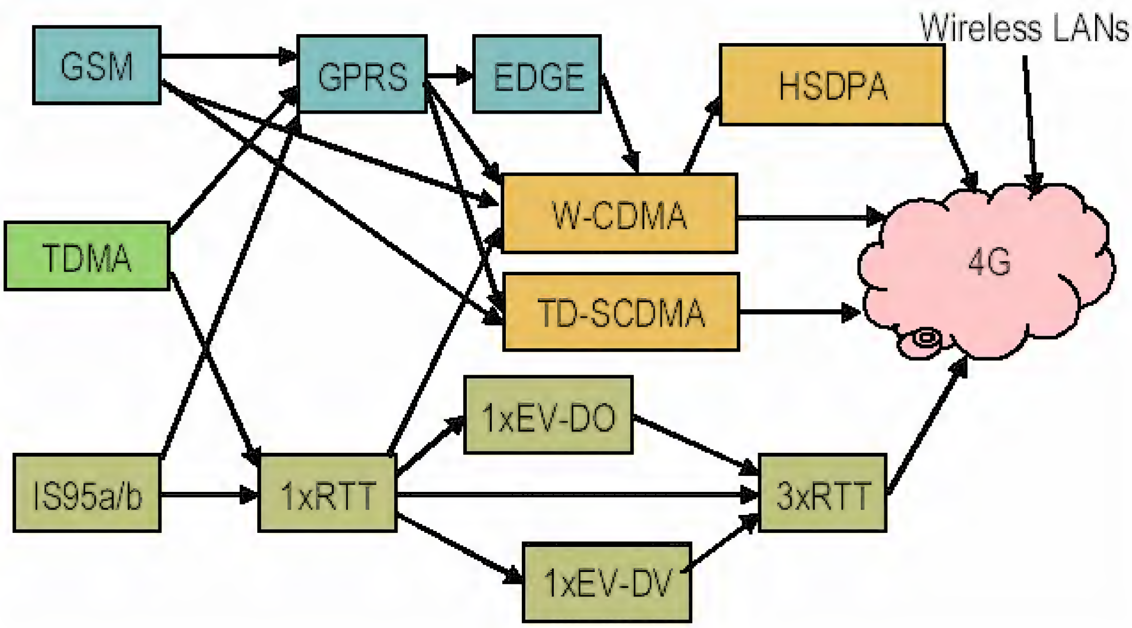
Topic: Instructor will take the trainee to the site of a cell station and will brief the trainee about working of a cell station.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Cellular Access Technology.

Introduction

Wireless is a term used to describe telecommunications in which electromagnetic waves (rather than some form of wire) carry the signal over part or all of the communication path. Some monitoring devices, such as intrusion alarms, employ acoustic waves at frequencies above the range of human hearing; these are also sometimes classified as wireless.

The first wireless transmitters went on the air in the early 20th century using radiotelegraphy (Morse code). Later, as modulation made it possible to transmit voices and music via wireless, the medium came to be called "radio." With the advent of television, fax, data communication, and the effective use of a larger portion of the spectrum, the term "wireless" has been resurrected.



There are three common technologies used by cell-phone networks for transmitting information:

Frequency division multiple access (FDMA)

Time division multiple access (TDMA)

Code division multiple access (CDMA)

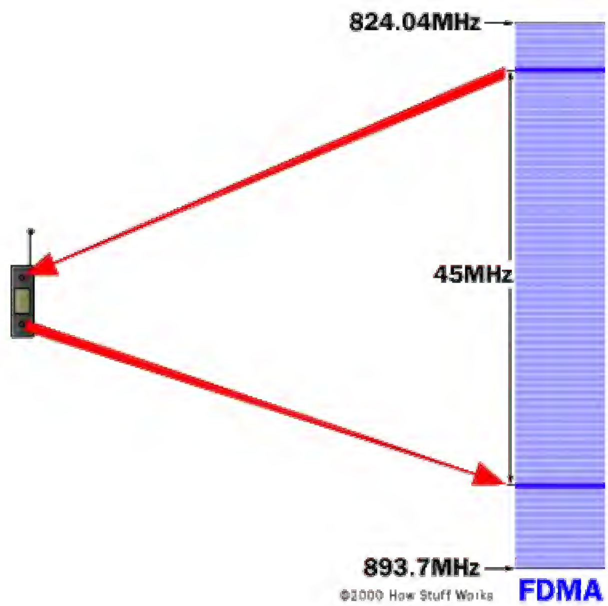
Although these technologies sound very intimidating, you can get a good sense of how they work just by breaking down the title of each one.

The first word tells you what the access method is. The second word, division, lets you know that it splits calls based on that access method.
FDMA puts each call on a separate frequency.
TDMA assigns each call a certain portion of time on a designated frequency.
CDMA gives a unique code to each call and spreads it over the available frequencies.
The last part of each name is multiple accesses. This simply means that more than one user can utilize each cell.

Concepts and Models

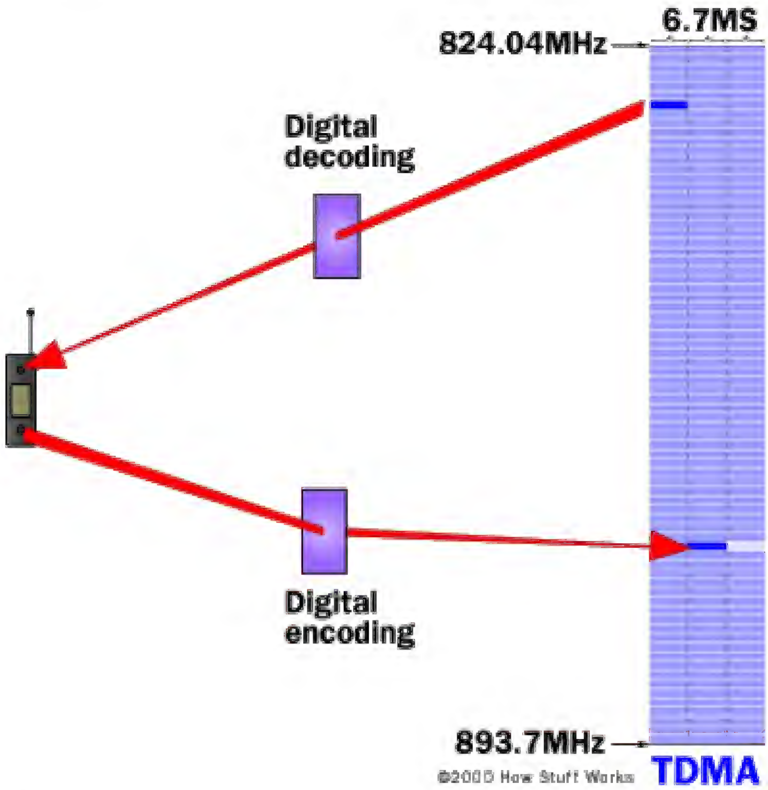
FDMA,

Cellular Access Technologies: FDMA
FDMA separates the spectrum into distinct voice channels by splitting it into uniform chunks of bandwidth. To better understand FDMA, think of radio stations: Each station sends its signal at a different frequency within the available band. FDMA is used mainly for analog transmission. While it is certainly capable of carrying digital information, FDMA is not considered to be an efficient method for digital transmission.
In FDMA, each phone uses a different frequency.



TDMA

TDMA is the access method used by the Electronics Industry Alliance and the Telecommunications Industry Association for Interim Standard 54 (IS-54) and Interim Standard 136 (IS-136). Using TDMA, a narrow band that is 30 kHz wide and 6.7 milliseconds long is split time-wise into three time slots.
Narrow band means "channels" in the traditional sense. Each conversation gets the radio for one-third of the time. This is possible because voice data that has been converted to digital information is compressed so that it takes up significantly less transmission space. Therefore, TDMA has three times the capacity of an analog system using the same number of channels. TDMA systems operate in either the 800-MHz (IS-54) or 1900-MHz (IS-136) frequency bands.

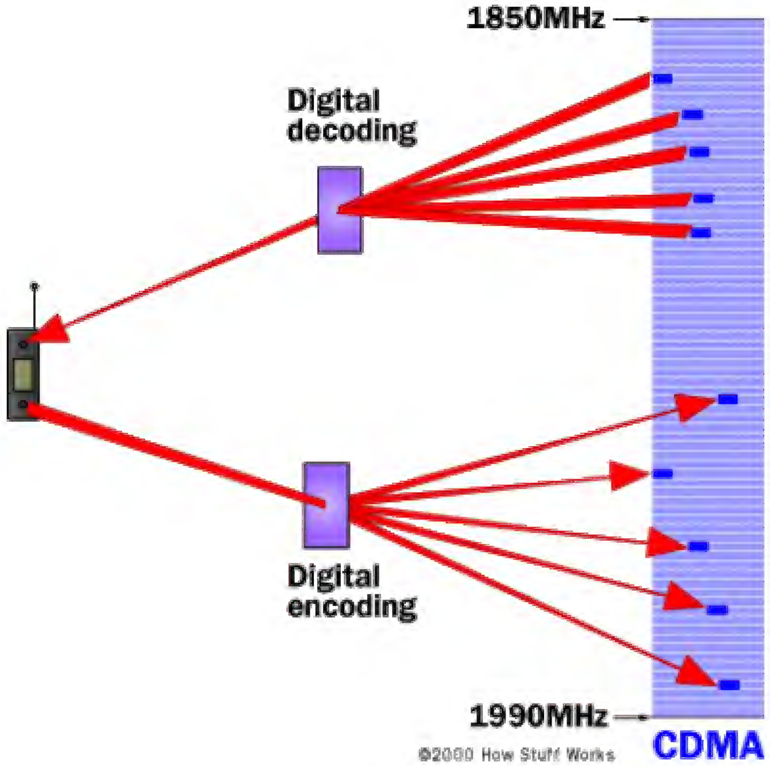


TDMA splits a frequency into time slots.

Cellular Access Technologies: CDMA

CDMA takes an entirely different approach from TDMA. CDMA, after digitizing data, spreads it out over the entire available bandwidth. Multiple calls are overlaid on each other on the channel, with each assigned a unique sequence code. CDMA is a

form of spread spectrum, which simply means that data is sent in small pieces over a number of the discrete frequencies available for use at any time in the specified range.



In CDMA, each phone's data has a unique code.

TDMA/GSM

TDMA is also used as the access technology for Global System for Mobile communications (GSM). However, GSM implements TDMA in a somewhat different and incompatible way from IS-136. Think of GSM and IS-136 as two different operating systems that work on the same processor, like Windows and Linux both working on an Intel Pentium III. GSM systems use encryption to make phone calls more secure. GSM operates in the 900-MHz and 1800-MHz bands in Europe and Asia, and in the 1900-MHz (sometimes referred to as 1.9-GHz) band in the United States. It is used in digital cellular and PCS-based systems. GSM is also the basis for Integrated Digital Enhanced Network (IDEN), a popular system introduced by Motorola and used by Nextel.

GSM is the international standard in Europe, Australia and much of Asia and Africa. In covered areas, cell-phone users can buy one phone that will work anywhere where the standard is supported. To connect to the specific service providers in these different countries, GSM users simply switch subscriber identification module (SIM) cards. SIM cards are small removable disks that slip in and out of GSM cell phones.

They store all the connection data and identification numbers you need to access a particular wireless service provider.
Unfortunately, the 1900-MHz GSM phones used in the United States are not compatible with the international system. If you live in the United States and need to have cell-phone access when you're overseas, the easiest thing to do is to buy a GSM 900MHz/1800MHz cell phone for traveling. You can get these phones from Planet Omni, an online electronics firm based in California. They offer a wide selection of Nokia, Motorola and Ericsson GSM phones. They don't sell international SIM cards.
All of the users transmit in the same wide-band chunk of spectrum. Each user's signal is spread over the entire bandwidth by a unique spreading code. At the receiver, that same unique code is used to recover the signal. Because CDMA systems need to put an accurate time-stamp on each piece of a signal, it references the GPS system for this information. Between eight and 10 separate calls can be carried in the same channel space as one analog AMPS call. CDMA technology is the basis for Interim Standard 95 (IS-95) and operates in both the 800-MHz and 1900-MHz frequency bands.
Ideally, TDMA and CDMA are transparent to each other. In practice, high-power CDMA signals raise the noise floor for TDMA receivers, and high-power TDMA signals can cause overloading and jamming of CDMA receivers.

Synchronization

To make this transmission method work it is not enough just to have a fancy coding scheme. To keep track of all this information flying back and forth we need to synchronize it with a master clock. As the CDG puts it, "In the final stages of the encoding of the radio link from the base station to the mobile, CDMA adds a special "pseudo-random code" to the signal that repeats itself after a finite amount of time. Base stations in the system distinguish themselves from each other by transmitting different portions of the code at a given time. In other words, the base stations transmit time offset versions of the same pseudo-random code." Arch. Another phrase with the word 'code in it, one more term to keep track of! Don't despair. Even if "pseudo-random code" is tiresomely titled, its chore is simple to state: keep base station traffic to its own cell site by issuing a code. Synchronize that code with a master clock to correlate the code. Like putting a time stamp on each piece of information. CDMA uses The Global Positioning System or GPS, a network of navigation satellites that, along with supplying geographical coordinates, continuously transmits an incredibly accurate time signal. What Every Radio System Must Consider Radio systems, like life, demand tradeoffs or compromises? The CDG says, "CDMA cell coverage is dependent upon the way the system is designed. In fact, three primary system characteristics-Coverage, Quality, and Capacity-must be balanced off of each other to arrive at the desired level of system performance."

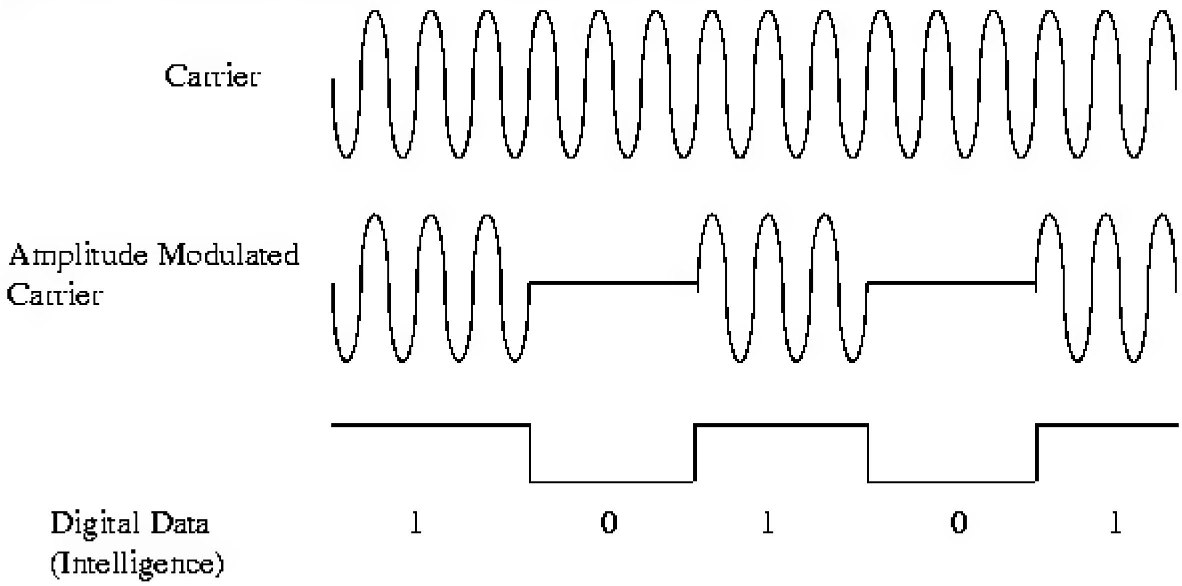
Wider coverage, normally a good thing, means using higher powered mobiles which means more radio interference. Increasing capacity means putting more calls into the same amount of spectrum which means calls may be blocked and voice quality will decrease. That's because you must compress those calls to fit the spectrum allowed. So many things must be balanced. As the saying goes, radio systems aren't just sold, they are engineered.

Modulation Techniques

Modulation techniques are methods that are used to encode digital information in an analog world. The 3 basic modulation techniques are as follows:
AM (amplitude modulation)
FM (frequency modulation)
PM (phase modulation)
All 3 modulation techniques employ a carrier signal. A carrier signal is a single frequency that is used to carry the intelligence (data). For digital, the intelligence is either a 1 or 0. When we modulate the carrier, we are changing its characteristics to correspond to either a 1 or 0.

AM - Amplitude Modulation

Amplitude Modulation modifies the amplitude of the carrier to represent 1s or 0s.In the above example, a 1 is represented by the presence of the carrier for a predefined period of 3 cycles of carrier. Absence--or no carrier--indicates a 0.



Advantages:

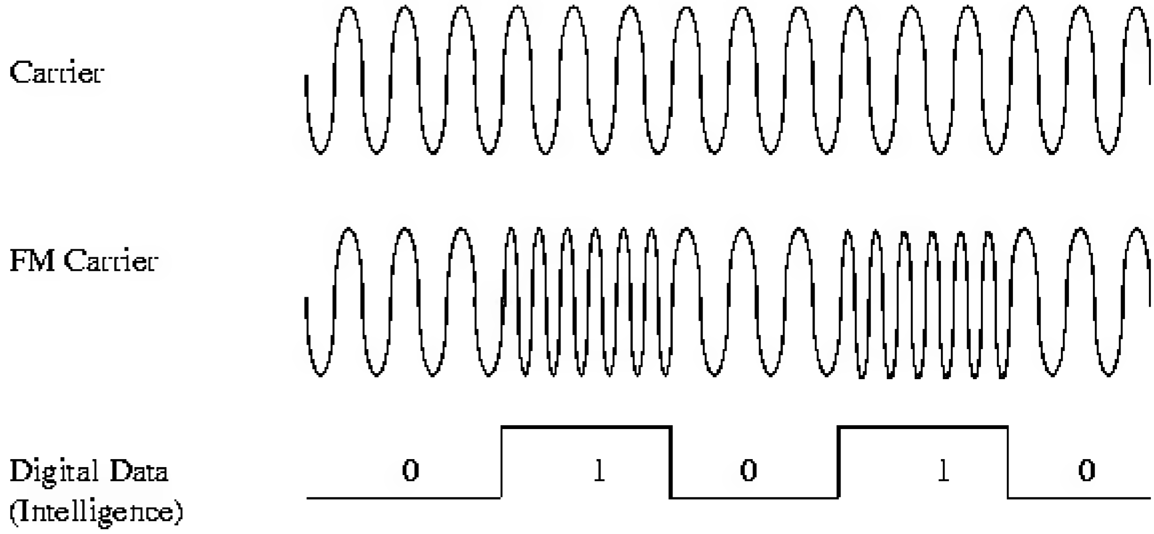
Simple to design.

Disadvantages:

Noise spikes on transmission medium interfere with the carrier signal.
Loss of connection is read as 0s.

FM - Frequency Modulation

Frequency Modulation modifies the frequency of the carrier to represent the 1s or 0s. In the above example, a 0 is represented by the original carrier frequency, and a 1 by a much higher frequency (the cycles are spaced closer together).



Advantages:

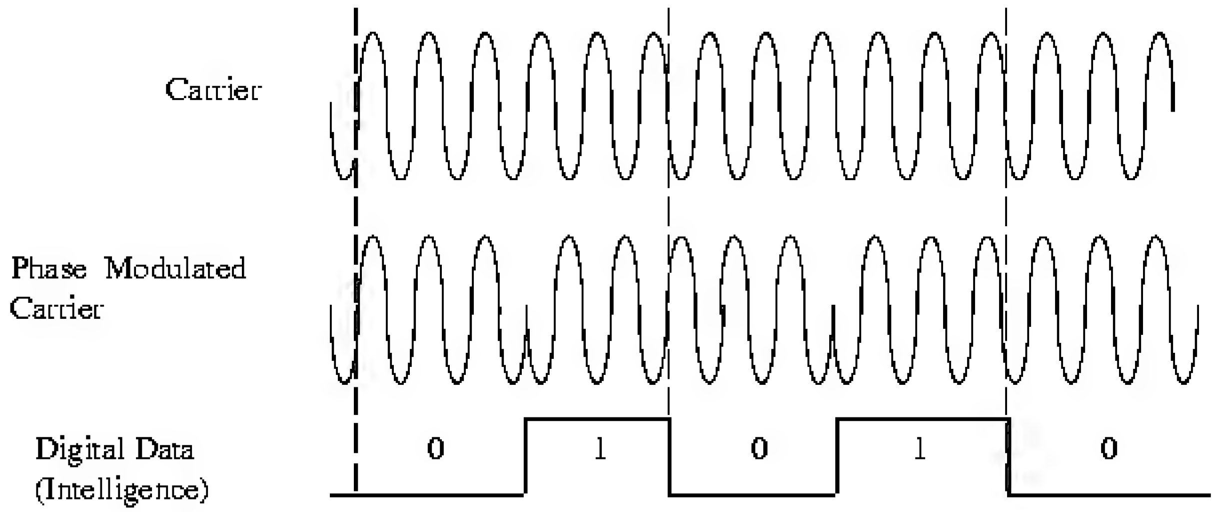
Immunity to noise on transmission medium.
Always a signal present. Loss of signal easily detected

Disadvantages:

Requires 2 frequencies
Detection circuit needs to recognize both frequencies when signal is lost.

PM - Phase Modulation

Phase Modulation modifies the phase of the carrier to represent a 1 or 0.



The carrier phase is switched at every occurrence of a 1 bit, but remains unaffected for a 0 bit. The phase of the signal is measured relative to the phase of the preceding bit. The bits are timed to coincide with a specific number of carrier cycles (3 in this example = 1 bit).

Advantage:

Only 1 frequency used

Easy to detect loss of carrier

Disadvantages:

Complex circuitry that is required to generate and detect phase changes.

Theory Questions

Q. Fill in the blanks

1. FDMA stands for ______________________________.
2. TDMA stands for ______________________________.
3. CDMA stands for ______________________________.
4. GSM stands for ________________________________.
5. FDMA puts each call on a ______________ frequency.
6. TDMA assigns each call a certain portion of time on a __________ frequency.
7. CDMA gives a unique code to each call and spreads it over the ___________.
8. FDMA separates the spectrum into distinct voice channels by splitting it into _________________________________.
9. FDMA is used mainly for ______________________.
10. The first word of each technology tells you about _____________.

Q. True or False

1. FDMA stands for Time division mutual access.
2. TDMA stands for Code division multiple access.
3. FDMA puts each call on a same frequency.
4. The last part of each name is multiple access.
5. TDMA is mainly used to access technology for Global System for Mobile communications (GSM).
6. GSM stands for Global System for Mobilink communications..
7. FDMA is used mainly for digital transmission.
8. GSM systems use encryption to make phone calls more secure.
9. In FDMA, each phone uses a different frequency.
10. Using TDMA, a narrow band is 40 kHz wide.

Q. Multiple Choice

1. TDMA is the access method used by the

a) EIA & TIA

b) PTCL

c) Mobilink

2. Using TDMA, a narrow band has frequency

a) 30 kHz wide

b) 40 kHz wide

c) 50 kHz wide

3. TDMA systems operate in either the 800-MHz (IS-54) or 1900-MHz (IS-136) frequency bands.

a) 500-MHz (IS-54) or 1900-MHz (IS-136)

b) 800-MHz (IS-54) or 1600-MHz (IS-136)

c) 800-MHz (IS-54) or 1900-MHz (IS-136)

Practical Exercise-1

Topic: Instructor will take the trainees to the switching station and demonstrate the working of a multiplexer.	Date:
<u>Findings</u>	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Practical Exercise-2

Topic: Instructor will take the trainee to the switching station and demonstrate the working of a switch.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Practical Exercise-3

Topic: Instructor will take the trainee to FM Radio station and explain the transmission system of FM station.	Date:
Findings	
Trainee Signature	
Instructor's Remarks	
Instructor's Signature	

Mobile Phone Structure

Analog & Digital Mobile Cell Phone Systems

Digital cell phones use the same radio technology as analog phones, but they use it in a different way. Analog systems do not fully utilize the signal between the phone and the cellular network -- analog signals cannot be compressed and manipulated as easily as a true digital signal. This is the reason why many cable companies are switching to digital -- so they can fit more channels within a given bandwidth. It is amazing how much more efficient digital systems can be.

Digital phones convert your voice into binary information (1s and 0s) and then compress it (see How Analog-Digital Recording Works for details on the conversion process). This compression allows between three and 10 digital cell-phone calls to occupy the space of a single analog call.

Many digital cellular systems rely on frequency-shift keying (FSK) to send data back and forth over AMPS. FSK uses two frequencies, one for 1s and the other for 0s, alternating rapidly between the two to send digital information between the cell tower and the phone. Clever modulation and encoding schemes are required to convert the analog information to digital, compress it and convert it back again while maintaining an acceptable level of voice quality. All of this means that digital cell phones have to contain a lot of processing power!

Cell Phone code

All cell phones have special codes associated with them. These codes are used to identify the phone, the phone's owner and the service provider.

Let's say you have a cell phone, you turn it on and someone tries to call you. Here is what happens to the call:

When you first power up the phone, it listens for an SID (see sidebar) on the control channel. The control channel is a special frequency that the phone and base station use to talk to one another about things like call set-up and channel changing. If the phone cannot find any control channels to listen to, it knows it is out of range and displays a "no service" message.

When it receives the SID, the phone compares it to the SID programmed into the phone. If the SIDs match, the phone knows that the cell it is communicating with is part of its home system.

Along with the SID, the phone also transmits a registration request, and the MTSO keeps track of your phone's location in a database -- this way, the MTSO knows which cell you are in when it wants to ring your phone.

The MTSO gets the call, and it tries to find you. It looks in its database to see which cell you are in.

The MTSO picks a frequency pair that your phone will use in that cell to take the call.

The MTSO communicates with your phone over the control channel to tell it which frequencies to use, and once your phone and the tower switch on those frequencies, the call is connected. You are talking by two-way radio to a friend!

As you move toward the edge of your cell, your cell's base station notes that your signal strength is diminishing. Meanwhile, the base station in the cell you are moving toward (which is listening and measuring signal strength on all frequencies, not just its own one-seventh) sees your phone's signal strength increasing. The two base stations coordinate with each other through the MTSO, and at some point, your phone gets a signal on a control channel telling it to change frequencies. This hand off switches your phone to the new cell.

Components of Mobile Phone

Antenna & Switch

It is the part of cell phone who receive and send the signals.







Filter & Duplexer

A component with a branch circuit, a transmission filter and transmitter in one package to allow sharing of an antenna between transmitter and receiver of a wireless two way communication device.
It prevents failure and damage to devices



Cellular phone use: GSM/AMPS/E-TACS/PDC RF and IF-stage It can also be used in other applications such as:

- Cordless phones
- Paging systems
- Remote controllers

Audio & Video units

The display has grown considerably in size as the number of features in cell phones has increased. Most current phones offer built-in phone directories, calculators and even games. And many of the phones incorporate some type of PDA or Web browser.



Speakers and microphones

Cell phones have such tiny speakers and microphones that it is incredible how well most



of them reproduce sound. As you can see in the picture above, the speaker is about the size of a dime and the microphone is no larger than the watch battery beside it. Speaking of the watch battery, this is used by the cell phone's internal clock chip.

CPU

The microprocessor handles all of the housekeeping chores for the keyboard and display, deals with command and control signaling with the base station and also coordinates the rest of the functions on the board.



ROM, Flash, Crystal

The ROM and Flash memory chips provide storage for the phone's operating system and customizable features, such as the phone directory. The radio frequency (RF) and power section handles power management and recharging, and also deals with the hundreds of FM channels. Finally, the RF amplifiers handle signals traveling to and from the antenna.





Some phones store certain information, such as the SID and MIN codes, in internal Flash memory, while others use external cards that are similar to Smart Media cards.

Circuit Boards

The circuit board is the heart of the system. Here is one from a typical Nokia digital phone:



In the photos above, you see several computer chips. Let's talk about what some of the individual chips do. The analog-to-digital and digital-to-analog conversion chips translate the outgoing audio signal from analog to digital and the incoming signal from digital back to analog. You can learn more about A-to-D and D-to-A conversion and its importance to digital audio in How Compact Discs Work. The digital signal processor (DSP) is a highly customized processor designed to perform signal-manipulation





calculations at high speed.

AMPS & GSMS sets

AMPS

In 1983, the analog cell-phone standard called AMPS (Advanced Mobile Phone System) was approved by the FCC and first used in Chicago. AMPS use a range of frequencies between 824 megahertz (MHz) and 894 MHz for analog cell phones. In order to encourage competition and keep prices low, the U. S. government required the presence



of two carriers in every market, known as A and B carriers. One of the carriers was normally the local-exchange carrier (LEC), a fancy way of saying the local phone company.

Carriers A and B is each assigned 832 frequencies: 790 for voice and 42 for data. A pair of frequencies (one for transmit and one for receive) is used to create one channel. The frequencies used in analog voice channels are typically 30 kHz wide -- 30 kHz was chosen as the standard size because it gives you voice quality comparable to a wired telephone.

The transmit and receive frequencies of each voice channel are separated by 45 MHz to keep them from interfering with each other. Each carrier has 395 voice channels, as well as 21 data channels to use for housekeeping activities like registration and paging.
A version of AMPS known as Narrowband Advanced Mobile Phone Service (NAMPS) incorporates some digital technology to allow the system to carry about three times as many calls as the original version. Even though it uses digital technology, it is still considered analog. AMPS and NAMPS only operate in the 800-MHz band and do not offer many of the features common in digital cellular service, such as e-mail and Web browsing.

GSMS

GSM (Global System for Mobile Communications):
CEPT initiated work in 1982, ETSI issued the standards in 1990 digital system, primarily for voice, data services on top (GPRS) There are other (old and new) cellular systems:
Andreas Willig Fundamentals of Cellular Systems and GSM



Theory Exercise.

Answer the following questions

1. How cell phone codes are are important to them?
2. What is difference between Analog and Digital devices?
3. How various Phone Models are identified?
4. What are the main components of a Mobile Phone?
5. What is the function of Filter?
6. What are Duplexers?
7. MTSO stands for? What is the function of MTSO?
8. What is function of Antenna and receivers?
9. What are Audio and video device used in Mobile phones?
10. What is the function of CPU?
11. What is meant by RAM? What are its various types?
12. What are various types of Charges?
13. Write common accessories use with Mobile Phones?
14. What is data cable?
15. What are PDAs?

Fill in the blank.

1. All cell phones have --------------associated with them.
2. ------------- prevents failure and damage to devices
3. Watch battery is used by the cell phone's ----------------------
4. The ------------------handles all of the housekeeping chores for the keyboard and display
5. The ROM and --------------- chips provide storage for the phone's operating system and customizable features, such as the phone directory
6. The --------------- handle signals traveling to and from the antenna.
7. Some phones store certain information, such as the SID and MIN codes, in---------------, while others use -------------- that are similar to Smart Media cards
8. Digital phones convert your voice into ---------------- and then compress it.
9. FSK uses -------------------, one for 1s and the other for 0s,
10. The digital signal processor (DSP) is a highly customized processor designed to perform ----------------- calculations at high speed.

Write True / False

1. When you first power up the phone, it listens for an SID
2. Cell phones have large speakers and microphones
3. Digital cell phones use the same radio technology as analog phones
4. Analog systems do not fully utilize the signal between the phone and the cellular network
5. Many digital cellular systems rely on frequency-shift keying (FSK) to send data back and forth over AMPS
6. The Filter is the heart of the system
7. The frequencies used in analog voice channels are typically 100 kHz wide
8. AMPS known as Narrowband Advanced Mobile Phone Service

Practical Assignment-1

Topic	**Assembling & Dissembling of AMPS sets**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-1I

Topic	**Speaker fault diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-1II

Topic	**Filter & Duplex faults diagnosing and rectification**

Finding

Instructor Remarks
Instructor Signature Trainee Signature

Practical Assignment-1V

Topic	**Audio & Video unit faults diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-V

Topic	**Hand free faults diagnosing and rectification**

Finding

Instructor Remarks
Instructor Signature Trainee Signature

Practical Assignment-V1

Topic	**Mother board faults diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-1IV

Topic	**Software faults diagnosing and rectification**

Finding

Instructor Remarks
Instructor Signature Trainee Signature

Practical Assignment-1IIV

Topic	**Memory faults diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-1X

Topic	**Use of data cables diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-X

Topic	**Transmitter and receiver faults diagnosing and rectification**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Basic Troubleshootings of Cell Phones

We've all heard the horror stories: The husband who thinks he's been asked to stop by the store on the way home for a gallon of silk and a loaf of lead. The unexpected roaming charges resulting in a monthly bill twice as high as what's expected. The purchase of a new phone that gets service all over town except for a hundred-foot radius surrounding the house. The battery life, once a copious several hours, now reduced to a mere 15 minutes of talk time. And of course, the service contract that Harry Houdini couldn't escape from. Perhaps something like this has happened to someone you know, or maybe even to you.

In the past decade cell phones have gone from being a luxury item enjoyed only by the richest of fast-talking communicators to an indispensable tool of everyday life for almost all of us. But the convenient ubiquity of cell phones has brought an unintended side effect: cell phone dependence. Our need to talk anywhere, anytime, has rendered us hostage to the vagaries of imperfect technology and the whims of powerful service providers. When your phone isn't working correctly, it can seem like your life grinds to a halt.

But when a cell phone malfunction brings you to your knees, you do have options. You mustn't, as many people assume, simply crawl back to your phone company to say, "Thank you, sir, may I have another?" Here are some tricks for dealing with temperamental phones and the sometimes-temperamental companies that supply them. They'll have you chattering away in no time.

Problems With Batteries

Battery problems are some of the most common woes afflicting cell phone users. It seems that after having the phone a few months, any important conversation will be interrupted by the beep, beep, and beep of the handset pleading to be plugged in. And of course, like a stubborn child, if you don't give it the electricity it wants, your phone will give you the silent treatment. We spoke to Betty V. of Sprint (http://www.sprintpcs.com/) and asked what a customer can do in the face of an unreliable rechargeable battery. Unfortunately, besides following the charging recommendations of the phone manufacturer, there's not a lot you can do to prevent or fix battery problems. The gradual performance loss is simply a limitation of the technology. However, there are ways around the greater problem; they just aren't free.

Assuming you don't want to spring for a whole new phone, you'll probably have to buy a new battery. This will definitely fix your problem with the least amount of hassle, but it will cost about $60. If you have time, your next step is to start trying to navigate the network's technical-support system. Betty recommended taking your phone to a local retail store. There, technicians can run diagnostic tests to determine if the battery and phone are functioning properly. Sprint provides a one-year standard warranty on its equipment, including batteries, so if your battery problems have set in early you may be, ironically, in luck

More often than not, batteries seem to have a sixth sense for the end of a warranty period. However, if you've paid the monthly surcharge for the equipment protection insurance, your battery is most likely covered, even against theft or accidental loss. Occasionally, some companies are reluctant to replace batteries that sort of work; if the battery holds a charge for 30 minutes or so, the technician may try to argue that it's experiencing normal deterioration with time. This has prompted a number of consumers to somehow manage to accidentally lose their batteries, but not their phones.

You may not want to rely on equipment protection plans, though. Most have a deductible that may be as high as $40. Factor in an extra few dollars a month for the insurance, and you can end up paying more than the cost of simply buying a new battery. Additionally, the fine print in most contracts specifies that companies can fulfill their replacement obligations with "refurbished" products. This means that your insurance may leave you with someone else's weak battery!

Failed Connections & Dropped Calls

"Can you hear me now? How about now?" The Venison commercials dramatizing the wireless testing process captured the frustration all of us have had when calls bug out. Unless you're in a major metropolitan area, and perhaps even if you are, you almost certainly experience occasional dropped connections, static, and inexplicably missed calls. We spoke with Chris, a T-Mobile representative, about what you can do to fix the problem. He explained that there are a whole litany of things that affect cell phone service and reception, ranging from topographical features, such as mountains and valleys, to bad weather and buildings. Obviously, you can't change most of those things. If your phone isn't getting service, your first step should be to check outside. Often just a few steps outside the perimeter of a building will let you get an otherwise unreachable signal.

If you have persistent service problems in a particular area, you should let your provider know about it. Wireless companies have to be very competitive to keep the consumer's business, and they want to know if there are legitimate holes in their networks. Sending an email with specific information will help the phone company assess the problem and plan a response to it. Make sure to include the exact location, time, the number you were calling, and the previous experience you've had with service there. Don't expect the problem to be fixed the next day. Chris says, "You probably won't see overnight improvement, but we are listening, and the information you provide us is extremely helpful for future planning."

If you're looking for immediate gratification, most providers will give you credit for dropped calls. For example, Sprint keeps a record of which calls were dropped and will give you a one-minute credit if you report the problem by dialing *2TALK. Not a permanent solution, but it might make you feel just a bit less indignant.

Ranges & Gaps In Service

Other problems can be more complicated. If you're talking in the car, the cell phone towers that receive and route your call have to seamlessly hand off the connection to each other as you drive down the road. If there's a gap in service or one tower drops the ball, your connection will be lost. Consequently, if you have an important call, you should probably pull over for the duration. It'll probably improve your driving too!

Because your phone is really talking to a whole network of towers, sometimes phones get lost on the network. If your handset has been on for a while and you notice that it doesn't have service, it may be that the network has misplaced it. Each tower keeps track of what phones are in its area, or cell. If the closest tower forgets about you, you won't be able to receive calls until you remind it where you are. You can usually re-establish a connection by turning the phone off and back on again. As it boots up, the phone sends out a greeting letting the nearest tower know it's there, getting you reconnected

Roam If You Want To

How often has your bill been unexpectedly high, only to discover that the charges are from only a few calls you made when you didn't know you were roaming? We used to experience this all the time, but there's plenty you can do about it. There are two types of roaming you need to worry about. The first is the kind that lets service providers extend their coverage by letting you use networks they don't own. Naturally, this entails an extra charge, but it's worth it if you need to make a call in a pinch.

Billing problems occur when you don't realize you're roaming and go on yakking,

oblivious to the per-minute charges you're racking up. Phones always display a graphic indicator when they're roaming, so if you don't know what one of those funny icons on your screen is, a quick spin through the manual could save a bundle on your bills. Some phones also have safety features to prevent you from accidentally roaming. Sprint's is called Call Guard, and it has options for roaming freely, roaming with a warning before each call, and locking out roaming altogether.

The second kind of roaming occurs when you've chosen a service provider that offers local plans. Sprint, for example, has a set of regional plans that sell you more minutes for less money but add a surcharge when you're away from home, even if you're still on its network. If you have one of these contracts and find yourself getting stuck with 50-cent-per-minute charges on your bill when you travel, you should consider switching to a nationwide plan. Even though you'll get fewer minutes per month for your money, you'll be free to use them where you want. Calling your company is all it takes to switch plans. However, switching may reset your long-term contract, so be sure to ask when you change plans.

You may have high bills even if you incur no roaming charges. If your plan allows you too many or too few minutes per month, you're probably paying too much, either for minutes you don't use or for expensive overage charges. Some companies let minutes "roll over," meaning you keep any minutes you don't use each month. Still, you'll save money by choosing the most appropriate plan for you. Phone companies are happy to switch your plan, and many will analyze your past few bills and make a recommendation. But be aware that you'll probably have to agree to a new long-term contract to change the plan. Make sure to ask the representative if this is the case, or you could be inadvertently locking yourself into a new plan for longer than you expect.

How To Switch Service & Keep The Same Number

But what if your trusty phone company doesn't have the plan you want? Or what if the reception just hasn't been measuring up? It might be time to switch to a different cellular provider. In the past, switching teams was virtually unthinkable because of the inconvenience of notifying friends, family, and colleagues of your new phone number. However, in November 2003, number portability became the law for many users. Now, subject to a few restrictions, you can take your wireless phone number with you when you switch companies. In fact, you can even transfer your home phone number to a cell phone.

After you've researched your options and perhaps even tested a few phones, it's time to do the switch. First, you'll need to check to make certain you can transfer, or port, your number. Numbers have to stay in the same geographical area. Call your new provider or visit its Web site; someone will tell you quickly whether your number is eligible.

Don't cancel your current service! The number has to be active to be ported. Get a copy of your most recent bill and contact your future provider to sign up. You can switch in person at a retail store, over the phone, or on the Internet, but because the new company needs to verify that you're the owner of the ported number, you won't be able to have someone else do it for you. In each case, representatives will prompt you for the information they need and process the switch in a few hours to a few days; you should expect service on both phones to be unreliable during the change.

Once you've switched and your new phone is working, you should call your old provider and cancel your old account. If it's before the end of your contract term, you may be required to pay the company an early termination fee, and you will, of course, need to remember to pay the last month's bill. After that, you're free to enjoy your new account

You Can Hear Me!

With all this talk of cell phone problems, it's easy to forget why we like them so much and why we're so dependent on them. The phones, services, and prices available today would have seemed like the stuff of science fiction just 20 years ago. Of course, like any technology, cell phones have their share of quirks, bugs, and inconveniences, but the technology is improving. One day soon, cell phones and towers will be as reliable and worry-free as landline telephones

SMS – Introduction

SMS enables you to send and receive short text messages using your
handheld and a GSM mobile phone. Most GSM mobile phone service providers have supported SMS (Short Message Service) technology for quite a while, and billions of SMS messages are exchanged each month. However, because it is so difficult to enter text on a cell phone keypad, many people don’t take advantage of this feature. Now, with SMS, you can use Graffiti® characters or the onscreen keyboard on your handheld to quickly create SMS messages, and you have the added benefit of a larger display when reading incoming messages. SMS also enables you to receive records associated with your other Palm OS® applications. For example, your boss can send you a Date Book event for a meeting you need to attend. When you receive the message, you can choose to add it to your Date Book or view the raw data as a text message.

Support and Troubleshooting

If you encounter a problem with your handheld or with SMS application, please do the following:

Check the troubleshooting information in the Getting Started guide and Handbook.

Check the settings on your handheld.

Contact your mobile phone service provider.

If you still need assistance and you contact Palm technical support, please have the following information ready:

The name and version of your computer operating system

The error message or problem you are experiencing

The steps you took to identify or reproduce the problem

The version of the handheld software you are using and the available memory on the device

For the SMS application

For problems encountered with the SMS application, review the following information:

problem	Solution
I cannot connect to my SMS center	Confirm that you have phone driver installed. configure Phone Preferences view the current phone your mobile phone options or your service provider's See "Setting Preferences" This guide for details.
I get an error that says SMS can't connect to my phone or that SMS is not Supported.	Make sure that you are using the correct phone driver for your mobile phone. Check the phone manufacturer's web site for a driver that is compatible with your Mobile phone.

Bluetooth troubleshooting

It is important to start by noting that Bluetooth wireless technology is a wireless standard and specification that product manufacturers build into their products. The manufacturer who produces the Bluetooth enabled product does so in compliance with an industry standard but integrates the technology into product in a unique way. Therefore, for technical support for Bluetooth enabled products, consumers should ultimately rely on the product manufacturer.

There are a few things you need to think about to get Bluetooth devices to work together. The most obvious being, of course, that you will need Bluetooth wireless functionality in all devices you want to connect.

Make sure that the corresponding Bluetooth profile[1] exists in booth devices

Make sure the devices have Bluetooth functionality "switched on

Make sure that the devices you want to communicate with are paired[3] with each other (exceptions exist, for example, when transmitting business cards)

Initiate a communication session

You've done everything right and it still doesn't work

Below you will find some general tips how to deal with potential problems in regard to Bluetooth connectivity and how to easily establish Bluetooth connections.

Making sure profiles match

For devices to work together it is important that each device that communicates share the same profile. Some examples:

If you want to connect a headset to a mobile phone you will need the headset profile in both devices

If you want to establish a dial-up session to reach the Internet from a PDA connected to a mobile phone, you would need the "dial-up networking" profile in both devices

If you want to print from a mobile phone to a printer, both devices typically will need the BPP (Basic Printing Profile)

These are just some examples, but when purchasing devices you need to keep this concept in mind to make sure that they will work together as expected. Usually you find information about what profiles are supported in the user manual.

An example that is not likely to work together:

A mouse which typically supports the HID (Human Interface Device) profile and a mobile phone is unlikely to work since presently no phones support HID

Bluetooth functionality must be switched on

For devices to communicate with the Bluetooth wireless technology you will need to make sure that both devices have the Bluetooth functionality on. Even though the basic design of Bluetooth provides for extremely low power consumption, the functionality can be switched off to save even more power, or to disable radio functionality in special situations such as during airplane take off. In most devices the Bluetooth functionality (radio) is switched on by software. This is typically done from a menu choice, "Turn Bluetooth radio on".

Pairing

Normally, for security reasons, two Bluetooth devices always need to be initially paired before they can exchange data. The term, pairing (or bonding as it is sometimes referred to), normally means that two devices are exchanging protected passkeys. Once paired, all information sent over the Bluetooth link is encrypted and will only be able to reach devices that are authorized to do so by the pairing process. At certain instances it makes sense to override pairing procedure. E.g. When exchanging business cards between two mobile phones it may be too cumbersome for pairing with password. Usually there is a setting in the device where you can set a lower level of security for such instances. It should also be noted that on some devices you will always need to make the device discoverable by setting the "discoverable menu" or preparing to accept business card (e.g. Sony Ericsson mobile phones).

Pairing procedure

Typically a pairing is done in two ways depending on type of devices. For example pairing a headset and a mobile phone necessitates setting one of the devices into parable mode and activating the pairing from the other device.

Headset is set into pairing mode, typically by specific sequence of key strokes

In the mobile phone, the pairing is activated by activating this function from the appropriate menu

Establish connection

With many devices, especially those which have built-in Bluetooth functionality, there is no need to perform additional operations to establish a connection once paired. e.g.

Typically, a mobile phone will automatically connect to the headset when a call is initiated.

Master/slave and multipoint

These are technical terms that most users do not need to worry about. However, for each small personal network (piconet), one device always acts as master and the other units are slaves. All devices independent of capability can take both master and slave role. If you have many devices connected in a personal network (more than one slave to a master) it is called multipoint. I.e. A computer could simultaneously connect and transmit data to both PDA, camera, and a mobile phone at the very same time.

Cannot pair devices

Usually, pairing between all devices is not a problem, however you will need to know how to initiate and make the initial pairing, which is described briefly above.
Most common problems are:
Devices cannot be found - Bluetooth is off or the other device is not in "discoverable mode". Make the unit you are trying to find and pair with visible/discoverable by either turning this on from appropriate menu or by a sequence of keystrokes usually on devices with limited user interface.
"Pairing unsuccessful" message appears usually this is the case wherein wrong pass code or PIN is entered when trying to pair

Pairing succeeded and it still does not work

One of the most common causes for devices not to work together is the fact that two devices do not support the same profile. Unfortunately, support in both ends is a requirement. Usually the answer to this question is to look in the manual where usually information about profile support id can be found. In many devices like PC's etc. it is also possible to look in the Bluetooth application to find out what profiles (or services) are supported.
Another common cause is, of course, that it is difficult to find the right commands or menus for making connections. This is more difficult to answer since it depends very much on manufacturer. The only recommendation would be to look in user documentation and/or to contact the device manufacturer's support department.

1. A profile is a way of describing Bluetooth functionality in different devices. Since the Bluetooth wireless technology is used for many different types of applications, it is necessary to describe how the different devices and their applications should operate together. This is called a profile. For example, a Bluetooth headset communicates with a mobile phone with a "headset profile". If only one of the devices has the same profile a communication is not possible. Typically, profile availability is found in the user manual.
2. In many devices the Bluetooth wireless technology can be switched off to save power consumption. Since the Bluetooth wireless technology consumes very little power, this is not possible in all devices.
3. Pairing (or bonding) is a concept introduced to create a first time recognition of what devices are allowed to communicate with each other or which devices belong together. Without an initial pairing, devices can usually not establish a communication session without a first time pairing.
4. Usually the Bluetooth device is in a power saving mode without regular transmission of data, unlike many other wireless technologies. Therefore, each application that wants to utilize the Bluetooth link needs to "activate" the Bluetooth link. Typically this is done automatically in the background and the user does not need to worry. This is especially true in devices with built-in Bluetooth.

Basic Troubleshooting of AMPS & GSMS

Faults and there rectification

The situations listed below are common problems that you may encounter when using your cellular phone either AMPS or GSMS

Problem	Solution
I pressed the power key but nothing happened.	Be sure to press and hold the power key until the display appears. Please ensure that the battery is fully charged.
The display says, "Insert SIM Card" even though I have already inserted it.	The SIM card may be incorrectly inserted. Ensure that you have inserted the SIM card properly.
The display indicates that my PIN is blocked. How do I unblock the phone?	After entering your PIN incorrectly three times sequentially, the SIM will lock itself. To unblock it, you must enter an unblocking key code (PUK).
My phone displays another carrier rather than T-Mobile on the screen.	This will occur if you are roaming outside of a T-Mobile coverage area. Visit www.t-mobile.com to verify your coverage area. Note: In California and Nevada, the phone displays Singular. This is to be expected. You are using the T-Mobile network. This occurs because T-Mobile and Singular work cooperatively in California and Nevada.
My phone will not ring.	If you see the silent or vibrating alert setting indicator on the display, then the ringer is turned off. Refer to the user manual for more assistance with changing the alert setting.
I tried to place a call and heard an alternating high/low tone.	Your call did not reach the system correctly. You may have dialed the number too soon after turning on the phone. Wait until the display shows "T-Mobile" before making a call. If it's still not working, verify that you are using 10-digit dialing and attempt the call again.

I cannot send or receive calls.	Ensure that you have an active signal on the phone. Avoid electrical or radio interference and obstructions such as bridges, parking garages, or tall buildings. Also, verify that your SIM card is installed and working and that your battery is charged.
My phone has poor reception and drops calls.	Ensure that you have an active signal on the phone. Stay clear of any obstructions such as bridges, parking garages, or tall buildings.
I cannot hear others on my phone.	Adjust the volume on the phone. Verify that you have an active signal on your phone. If using the headset, check that your phone's earpiece is inserted correctly.
How do I view a listing of missed calls and received calls?	To view a listing of your most recent calls: From the start screen, select Menu. Use the arrow key to scroll to the Call Log menu and select it. Scroll to Missed Calls or Received Calls and select it. To view a listing of the calls you have recently made, press the Send button from the start screen.
How do I read text messages?	When you receive a new message, your phone beeps and displays "Message Received". To read the message, select Show. To access a new message stored in the inbox: From the start screen, select Menu. Scroll to Messages and select it. Scroll to Text Messages and select it. Scroll to Inbox and select it. Scroll to the message that you want to view and select it.

How do I delete text messages?	To delete text messages: From the start screen, select Menu. Use the arrow key to scroll to the Messages menu and select it. Scroll to Text Messages and select it. Scroll to Inbox and select it. Scroll to the message you want to delete and select it. When the message opens, select Options > Delete. A message will display asking if you want to delete the message. Select OK to delete the message.
I see the message, "Action failed" when I download a game.	You may have too many games saved on your phone. Perform the following to free up some memory space: At the main screen, select Menu. Scroll to Games > Select game. Scroll to the desired game and select Options > Delete.
I am a t-zones subscriber and the phone displays, "Network not available."	Make sure it has been 24 hours since you have registered for the t-zones service. Verify that you have the correct SIM card in the phone. Turn your phone off and on and retry. This message means that the T-Mobile network is unavailable, which may be caused by low signal. Contact Customer Care for further assistance. Inform them when you activated the service and when the problem started.
The phone displays, "Application	You already have the game downloaded on the

w.jad is already installed".	phone.
I can make calls but I can't receive!?	If you can make calls without interference or distortion, it is probably not a problem with your phone or your network connection. The most probable cause is that your calls are being diverted to another phone number. Ask yourself this. Have you set a diversion to another number when someone calls you and forgotten to take it off? Or has someone else who may have used your phone done it? Most of today's phones have an option that lets you cancel all existing diverts that you may have set. Use this option or call your service provider if the problem persists.
I can receive calls but I can't make any!?	There are two possible cases for this problem. If you have a digital phone, take your SIM card out and install it in a friend's phone and test if you can make calls. The other cause could most likely be that your outgoing calls have been suspended by your service provider, due to non payment of bills, etc. Call up the service provider if the problem persists
My calls drop out all the time!?	The most probable cause could be that your service provider does not offer cell phone coverage in that area. Try to find out if this problem exists in a particular area. Make calls from another area. Also, it could be a temporary problem whereby your provider is doing an upgrade and has a few cell phone towers turned off. Call up your service provider if the problem persists.
My phone switches itself off!?	There are three possible causes of this: ▸ The batteries of your cell phone cannot keep good contact with the phone which results it to turn off when carried around. Consult your provider for this.

	‣ A loose battery can be another cause. Remove your batteries when the phone is on and determine if it switches off. If this does happen, the mounting points on either the batteries or the phone itself are worn out. Contact your provider for support on this. ‣ The "Off" button on your keypad was accidentally hit when carrying around the phone in your pocket or purse. Most of today's phones come with an option that allows you to prevent keys from being accidentally hit (also known as key lock feature). Consult your technical manual on how to set key locks on your phone.
My phone displays a flashing envelope which won't go away even though I've cleared all my messages!?	Follow the prompts at the end of each message to cancel them. Consult your user manual for more on this. A static (not flashing) envelope means you have incoming messages stored on the phone while a flashing envelope means that the message capacity of your phone is full and messages must be cleared. Just like emails, it's a good practice to delete unimportant messages so that you can store the important ones.
What's that infernal noise from my car radio when my phone is about to ring!?	All electronic merchandise emits a radio signal of various types. This happens even if the merchandise is not a computer, microwave, television or radio, etc. If the appliance is in close proximity to the cell phone and while the phone is in a call session, radio signals may be emitted. Your other electronic appliances will not be damaged though
failing to register to network failing to accept SIM Card	Out of network area, change the location Incompatible SIM, change SIM card Phone Does not support the network band, check your service provider

I pressed the power key but nothing happened.	Be sure to press and hold the power key until the display appears (this could take a couple of seconds). Please ensure that the battery is fully charged.
The display says: Insert SIM or Check SIM Card even though I have inserted my SIM card in the phone.	The SIM card may be incorrectly inserted. Check the SIM card to ensure that it is inserted properly.
The display is prompting me to enter a Phone Lock code. How do I unblock the phone?	After entering the PIN incorrectly three times sequentially, the SIM will lock itself. To unblock it, you must enter an unblocking key code (PUK).
My phone displays another carrier other than T-Mobile on the screen.	This will occur if you are roaming outside of a T-Mobile coverage area. Visit http://www.t-mobile.com/ to verify your coverage area. Note: In California and Nevada, the phone displays Singular as its carrier because T-Mobile and Singular work cooperatively in California and Nevada.
My phone does not ring.	Make sure that the volume is turned up on your phone. To change the volume setting, select Settings from the main menu, and select Sounds & Alerts > Ring Volume. Press the joystick up or down to adjust the volume level. Select Save when done.
I tried to place a call and heard an alternating high/low tone.	Your call did not reach the system correctly. You may have dialed the number too soon after turning on the phone. Wait until the phone displays, "T-Mobile" before making a call. If it still does not work, verify that you are using 10-digit dialing and attempt the call again. .
I cannot send/receive calls.	Ensure that you have an active signal on your phone. Avoid electrical or radio interference and

	obstructions such as bridges, parking garages, or tall buildings. Also, verify that your SIM card is properly inserted. .
My phone has poor reception and drops calls.	Ensure that you have an active signal on your phone. Stay clear of any obstructions such as bridges, parking garages, or tall buildings. .
I cannot hear others on my phone.	During a call, press the "+" or "-" buttons on the side of the phone to change the volume. Your phone display should show the volume increasing or decreasing. Verify that you have an active signal. If using a headset, verify that your phone's earpiece is inserted correctly. .
How do I access a list of the calls that I have sent or received?	To view a listing of the most recent calls either sent or received, Press the joystick down to display the main menu. Scroll to Calls and select it. >Scroll to Call List and select it to view a listing of sent or received calls.
How do I read text messages?	When you receive a new message, your phone alerts you of the new message. Select Yes to view the message. To access stored messages: Press the joystick to access the main menu. Select Messaging > Text. Scroll to Inbox and select it to view received text messages.
How do I delete text messages?	To delete text messages: Press the joystick to access the main menu. Select Messaging > Text. Scroll to Inbox and select it. Scroll to the message you want to delete and select more.

	Scroll to Delete and select it. To delete all text messages, scroll to Delete All and select it.
When sending a picture to e-mail or another phone number, one of these error messages displays: "Network communication problem error message; please check your settings and try again" "GPRS Failed" "Message has been rejected."	When you send a picture message to another phone or e-mail, your phone must be connected to the network in order to send that message. When there is a failure in the transmission of data, you will receive the Network Communication Error message. Your phone must be connected to the wireless network in order to transmit data files (your Picture Message is comprised of data files). In some instances, the network may be temporarily unavailable. We work hard to resolve network issues quickly, which means that you will be able to send the message from the Unsent folder as soon as these issues are resolved. Your unsent message will remain in this folder until it is successfully sent.
When I send a picture message to another phone, I receive the error message: "Phone Number can only receive text messages. Your Picture Message was sent as text only."	When sending a picture message to another phone, the recipient MUST have a phone that is capable of receiving picture messages and MUST have a t-zones account. If the recipient does not have a supported phone, the picture will be stripped and the recipient will receive the message as text only. The image will NOT come through at all, and it is possible that only a portion of the text will be transmitted.
When I insert a game card, it takes several seconds for the N-Gage to load it.	The amount of time it takes to load will vary from game to game. The delay is experienced while the N-Gage reads the file from the card and prepares system resources to execute the file.
How can I check on the amount of data I've used?	This log indicates the exact amount of data used and should be used for estimation purposes only! T-Mobile will round up each GPRS data session to the nearest 10KB. From the main menu, select Log.

	Select GPRS Counter. Select All Sent Data or All Received Data.
When I use my N-Gage the operating system seems to be operating sluggishly, or my MMS usage is impaired.	System performance will improve when you quit an application that is using a large amount of memory. To view free memory and catalog RAM/MMC card usage on the N-Gage: From the main menu, select Tools > Manager. Select Options. Scroll to Memory Details and select it. Press right on the five-way scroll button to reveal the sub-menu items Phone Memory and Memory Card. Press the five-way scroll button to select the memory of choice. After a few seconds of scanning, a catalog is displayed showing how many kilobytes are used by various databases and applications.
I'm not receiving any calls	Check the volume switch on your telephone If you have Call Minder in your home, check that the ringing option is set to more than 0 rings Check the number of phones and other equipment in your house such as faxes, you may have exceeded the RAL(Ringer Approximated Loading) Every telephone / fax has a Ringer Approximated Loading (RAL) which is the amount of current the device needs to ring correctly. The RAL value is shown on the Teleprompt label on your phone or fax. The sum of all RALs of the equipment connected to your line should not exceed five.
When I'm talking on the phone, the other person cuts off	If you have a monitored alarm system, check with your alarm company to see what time the alarm does a "self test" or resets. This is when the alarm system dials up the security company to "check in". To

	avoid disruption to your phone service it should be set at a time when you would not normally use the phone such as the middle of the night.
I hear noise/conversations/radio on my phone	If you are using a cordless phone, try changing the frequency channel. It could be due to other interference from television transmitters. Please call us on 120.
I'm calling someone on their landline and I receive a message which says, The mobile phone is switched off or out of the coverage area.	The number your are calling has been redirected to a mobile phone, which is either switched off or outside the coverage area.
Charging the battery	Install only Global star batteries Check that the battery contacts are clean and dry Check the charger connection Check the battery temperature. If it is too warm; allow it to cool before recharging it Replace the battery if it is several years old
Battery draining quickly	Check that your Globlastar satellite antenna is pointing straight up and has a clear view of the sky to conserve battery life Set the backlight option to "off" Replace the battery if it is several years old Check the battery temperature. If temperatures are too warm or too cold, battery life is decreased
I pressed the power key but nothing happened.	Be sure to press and hold the power key until the display appears. Please ensure that the battery is fully charged. For more assistance with the battery,

	refer to the user manual.
The display says, "Insert SIM Card" even though I have already inserted it.	The SIM card may be incorrectly inserted. Ensure that you have inserted the SIM card properly. For more assistance, refer to the user manual.
The display indicates that my PIN is blocked. How do I unblock the phone?	After entering your PIN incorrectly three times sequentially, the SIM will lock itself. To unblock it, you must enter an unblocking key code (PUK). Contact T-Mobile Customer Care at 1-800-937-8997 to receive an unblock code.
My phone displays another carrier rather than T-Mobile on the screen.	This will occur if you are roaming outside of a T-Mobile coverage area. Visit www.t-mobile.com to verify your coverage area. Note: In California and Nevada, the phone displays Singular. This is to be expected. You are using the T-Mobile network. This occurs because T-Mobile and Singular work cooperatively in California and Nevada.
My phone will not ring.	If you see the silent or vibrating alert setting indicator on the display, then the ringer is turned off. Refer to the user manual for more assistance with changing the alert setting.
I tried to place a call and heard an alternating high/low tone.	Your call did not reach the system correctly. You may have dialed the number too soon after turning on the phone. Wait until the display shows "T-Mobile" before making a call. If it's still not working, verify that you are using 10-digit dialing and attempt the call again. .
I cannot send or receive calls.	Ensure that you have an active signal on the phone. Avoid electrical or radio interference and obstructions such as bridges, parking garages, or tall buildings. Also, verify that your SIM card is installed and working and that your battery is charged. .

My phone has poor reception and drops calls.	Ensure that you have an active signal on the phone. Stay clear of any obstructions such as bridges, parking garages, or tall buildings. .
I cannot hear others on my phone.	Adjust the volume on the phone. Verify that you have an active signal on your phone. If using the headset, check that your phone's earpiece is inserted correctly. .
How do I view a listing of missed calls and received calls?	To view a listing of your most recent calls: From the start screen, select Menu. Use the arrow key to scroll to the Call Log menu and select it. Scroll to Missed Calls or Received Calls and select it. To view a listing of the calls you have recently made, press the Send button from the start screen. Contact T-Mobile Customer Care at 1-800-937-8997 for additional assistance.
How do I read text messages?	When you receive a new message, your phone beeps and displays "Message Received". To read the message, select Show. To access a new message stored in the inbox: From the start screen, select Menu. Scroll to Messages and select it. Scroll to Text Messages and select it. Scroll to Inbox and select it. Scroll to the message that you want to view and select it. Contact T-Mobile Customer Care at 1-800-937-8997 for additional assistance.
How do I delete text messages?	To delete text messages: From the start screen, select Menu. Use the arrow key to scroll to the Messages menu

	and select it. Scroll to Text Messages and select it. Scroll to Inbox and select it. Scroll to the message you want to delete and select it. When the message opens, select Options > Delete. A message will display asking if you want to delete the message. Select OK to delete the message.
I see the message, "Action failed" when I download a game.	You may have too many games saved on your phone. Perform the following to free up some memory space: At the main screen, select Menu. Scroll to Games > Select game. Scroll to the desired game and select Options > Delete.
I see the message, "Invalid file" when I download a game.	Contact Customer Care at 1-800-937-8997.
I see the message, "Application not supported" when I download a game.	Contact Customer Care at 1-800-937-8997.
I am a t-zones subscriber and the phone displays, "Network not available."	Make sure it has been 24 hours since you have registered for the t-zones service. Verify that you have the correct SIM card in the phone. Turn your phone off and on and retry. This message means that the T-Mobile network is unavailable, which may be caused by low signal. Contact Customer Care for further assistance. Inform them when you activated the service and when the problem started. To contact Customer Care, dial 611 from your

	handset or call 1.800.937.8997 from a landline phone.	
You receive one of the following errors: Server not responding T-Mobile Wireless Error 401 Page cannot be found T-Mobile Wireless Error 500 Gateway not responding Unsupported content type Malformed content Service not available	These error messages are related to the t-zones service. Go to http://www.t-mobile.com/help/services/tz.asp for t-zones troubleshooting information.	
The phone displays, "Application w.jad is already installed".	You already have the game downloaded on the phone.	
Problem	Possible Cause	Solution
Phone shows “No Service”	Out of coverage area Antenna problem System preference set to something other than “ Only” Prepaid cellular outside Saskatchewan Using an analog phone digital coverage-only area	Change area Check the antenna Contact to Service provider Phone OS System refresh Use digital set
Cannot make calls	Phone is turned off	Check if power Enter unlock

	Phone is locked Fuse is blown in adapter Battery is dead Prepaid cellular outside Saskatchewan Roaming in a non-agreement area Out of coverage area Using an analog phone digital coverage-only	See your SaskTel Recharge your Prepaid cellular receive calls call within Saskatchewan Move location, Move location, Move to an coverage, or
Cannot receive calls	Call Forwarding is System preference something other B Only" Also see causes and for 'Cannot make calls' Using an analog phone digital coverage-only	Press *720S Change to "B Only" or "Prefer Move to an area with analog coverage, or use a digital
Fast Busies when you press S	Network congestion – channels are busy Problem with phone antenna	Try call again

Busy signal when accessing Voice Message Service mailbox	Call Forward Busy is deactivated	Press *90S
Static/Cut-offs during conversation	Weak signal – moving outside wireless coverage area Antenna or phone problem	Refer to coverage map. Move location, try call again.
Calls not being transferred to Voice Message Service mailbox	Call Forward may be activated Call Forward No Answer not active to mailbox	Press *720S Press *92#, followed by three zeros (000) and the seven-digit cellular number, then S.

Mobile Phone Beeps

Before you dial		
Long beeps	____ ____	The number you are calling from is not connected. You may want to ensure your account is up to date by dialing 0800 000 000 from another phone, then entering Quick Code 7602, or calling 128
Long, short, long ring tone	____ ____ _	The phone line you are calling from has been diverted to another number
8-10 short beeps then normal dial tone resumes	-------- __________	Call Minder message waiting tone
When you have finished dialing		
Four quick beeps	---- ----	The number you are calling has either been disconnected or no such number exists
Slow beeps	____ ____	The number you are calling is busy/engaged

Check for a switch on the bottom or side of the telephone with a "P" to one side and "T" to the other side. Make sure that the switch is on the "T" side. If your phone is on pulse, when you push the buttons on your phone, you will hear a clicking noise. If your phone is on pulse, you will not be able to use any automated services such as telebanking or Call Minder as it does not recognize the clicking noise. This is how a phone on the pulse setting sounds.

If your phone is on tone, you will hear normal beeping noises when pushing the buttons on your phone. This is how a phone on the tone setting sounds.

If you have the Call Minder service, check that there are no new messages to be saved or deleted.

This is how a phone with the Call Minder Message Waiting Tone sounds.

If you have the Call Diversion service, check to see that it is de-activated. This is how the Call Diversion Tone sounds when activated.

If you are using a cordless phone, try changing the frequency channel.

Blackberry 7510 Troubleshooting Guide

The Blackberry device relies on digital cellular service for cell phone and e-mail functionality. Unlike other devices, it will not operate in an "analog only" area.



Cannot make a cellular connection

1. Check the battery charge level as shown by the battery icon on the top left of the home screen.

No Power - Battery Charge Indicator does not show a charge or is very weak. The battery icon may be red. The solution: charge the battery.

Adequate Power - battery icon shows some charge - Go to step 2

2. Check the Signal Strength Indicator on the home screen. (1 to 5 bars, as shown below, indicating signal strength). If there is no signal, you may be out of range of the Nextel network.

If you are sure you are in range of the network, but show no signal strength, press Alt-Right

Shift-Del at the same time. This will cause the Blackberry to reacquire a network connection.

The process for this procedure is:

1. Press Alt-Right Shift-Del (The Del key is also the Backspace key.)

2. The screen will go blank, and an hourglass will appear. Wait for the hourglass to go away.
3. The Nextel startup screen will appear. Wait for it to go away.
4. A screen that says Verifying Security Software will appear. Wait for it to go away.
5. Check the Radio Tower icon. If you see this icon, click it to turn on the wireless service.
3. Look at the Connection Status letters. The best indicator of a good digital connection is when the capital letters NXTL appear to the left of the signal strength icon. Capital letters mean you can do something, lower case letters or no letters mean you cannot. When a capital N appears, you can place and answer phone calls, and receive SMS messages. If this letter is lower case, you can't do this. When a capital X appears, you can place and receive Nextel Direct Connect calls. If this letter is lower case, you can't do this.

When a capital T and L appear, you can send and receive email and PIN messages, and browse web pages. If these letters are lower case, you can't do this.

Intermittent or No cellular signal

1. Is the Phone turned off? - check the Signal Strength Indicator. If the word OFF appears, turn the wireless feature on. Use the track wheel to scroll to the Radio Tower icon.
This icon indicates that wireless service is OFF: Click it to turn wireless service on.
It may take several seconds after clicking for the Signal Strength to appear. If you are within a building, move to an outside wall, preferably near a window, or go outside.
2. Check your location in your cellular provider's coverage area. (Nextel Coverage) If you are within the Nextel coverage area, the signal may be blocked by surrounding hills or buildings. Move to a different location.

Note: When first powering on the Blackberry, wait 30 seconds or more for the device to acquire a cellular signal. This will be indicated by 1 to 5 bars appearing on the Signal Strength Indicator. Attempting to access the Nextel On-Line network before the signal has been acquired will cause an error message to be displayed.

Theory Exercise

Answer the following questions

1. What is meant by Troubleshooting?
2. What are the key points of Mobile phone repairing?
3. What is difference between AMPs and GSMs sets?
4. What are equipment especially used in Mobile Repairing & Troubleshooting?
5. What is the difference in Hardware and Software troubleshooting?
6. Enlist some common faults you encounter while using Mobile Phone?
7. What is mobile OS?

Fill in the blank.

1. In the past decade cell phones have gone from being a ---------------- enjoyed only by the richest of fast-talking --------------to an indispensable tool of everyday life for almost all of us
2. SMS enables you to send and receive ------------------- using your handheld and a GSM mobile phone.
3. Even though the basic design of ----------- provides for extremely low power consumption.
4. OS stands for ---------------.
5. When your phone shows message “no network”---------------.
6. Be very careful while doing ------------------ work.
7. --------------Help you to solve the most common Mobile phone problems.
8. Presently, --------------sets are in use in Pakistan.
9. Take care of phone ------------ the most.

Write True / False

1. Battery problems are some of the most common woes afflicting cell phone users.
2. The gradual performance loss is simply a limitation of the technology.
3. Most GSM mobile phone service providers have supported SMS
4. *Bluetooth* wireless technology is not a wireless standard
5. For devices to communicate with the *Bluetooth* wireless technology you will need to make sure that both devices have the *Bluetooth* functionality on
6. Two *Bluetooth* devices always need to be initially paired before they can exchange data
7. A profile is a way of describing *Bluetooth* functionality in different devices.
8. *Bluetooth* headset communicates with a mobile phone with a "headset profile
9. Bluetooth need wire to connect a mobile phone.
10. Antenna problem in Mobiles is common.

Practical Assignment-I

Topic	**Mobile Phone is not working at all**

Findings and rectification

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-I1

Topic	**Identification and rectification of various Mobile Phone noises**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-II1

Topic	**Batteries faults identification and rectifications**
Finding	

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-IV

Topic	**Mobile Phone Failed Connections & Dropped Calls reasons and rectification measures**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-V

Topic	**Mobile Phone unlocking codes**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-V

Topic	**Mobile Phone Software troubleshooting**
Finding	

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-VI

Topic	**Mobile Phone Hardware troubleshooting**
Finding	

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-VII

Topic	**Troubleshooting Nokia set**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-VIII

Topic	**Troubleshooting Samsung set**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-IX

Topic	**Troubleshooting Motorola set**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-X

Topic	**Troubleshooting Siemens set**

Finding

Instructor Remarks	
Instructor Signature	Trainee Signature

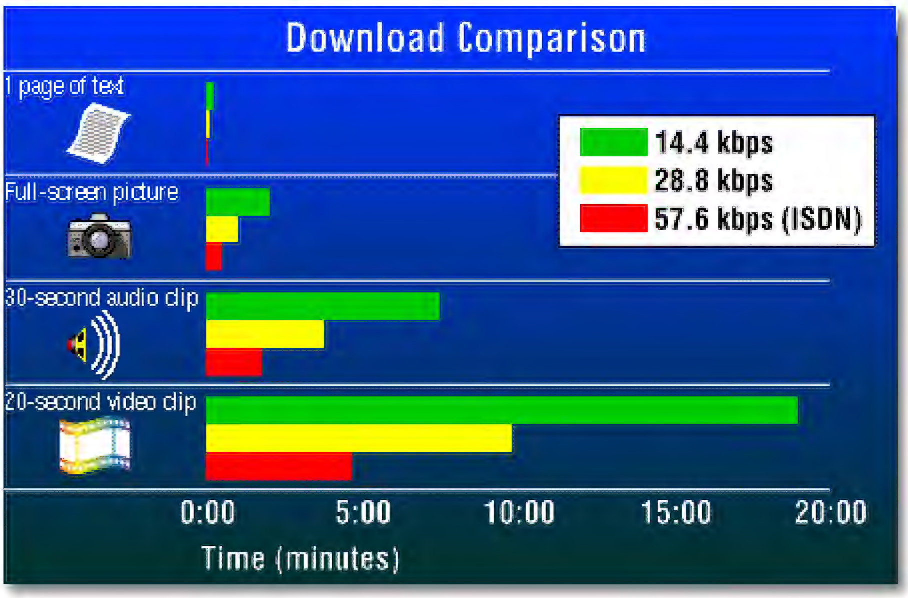
Mobile Phone and Computer System

Net surfing

Despite the increasing availability of high-speed, broadband Internet service, most people still access the Web with a dial-up account. Waiting for media rich web pages to download can be frustrating, as is trying to find specific information in a sea of data. To make Web surfing a more satisfying and productive experience, we offer these tips:

Get a faster connection.

If you are still using a 56 Kbps modem, it's time to upgrade. Consider getting a high-speed service such as DSL or cable modem. It may cost a bit more, but it will greatly improve your satisfaction.



Use the Stop button.

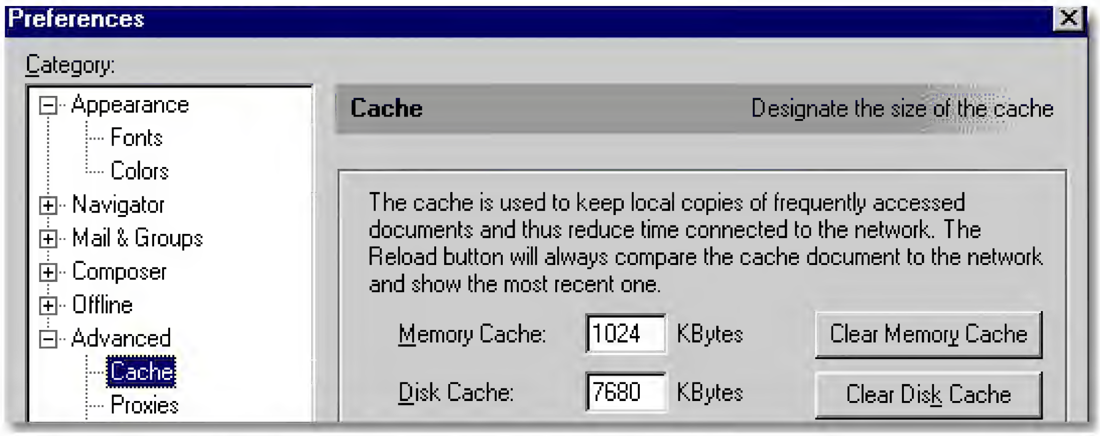
When you access a website, what you are actually doing is downloading digital files. You can see how the download is progressing by looking at the status bar located in the lower left-hand corner of your web browser. If you get tired of waiting, click the Stop button to view the files that have already downloaded. Then you can decide if you want to continue. If you do, click the Reload or Refresh button.



Increase your cache.

Files you download are stored in a cache (pronounced like "cash") on your hard drive. That way when you return to a site, you don't have to download the files again from the

server, just access them locally from your cache. After a while though, the cache becomes full. Your web browser automatically deletes old files as you continue to surf the Web. But if you visit many of the same sites regularly, you can speed up access by caching more of them. To do this, increase the size of your cache. 10 Mb is optimal.
If you use Netscape Navigator 4.0 or a later release, under the Edit menu, choose Preferences, and then click on Advanced. Now click on Cache. In the appropriate box, increase the cache size.



With Explorer 5.0 or later, under the Tools menu, select Internet Options. Next, on the General tab, click on Settings. Use the slider to increase the cache.
Save keystrokes by using Bookmarks or Favorites.
Web addresses or URLs can be unwieldy. Worse, if you type them wrong, you get an error message. To avoid these problems, save the addresses of sites you want to revisit. For details on how to do this, read the Bookmarks and Favorites article.



Use the Find feature of your web browser.
Once you've accessed a web page, use the Find feature to quickly locate a particular term that interests. Why take the time to scroll through the entire document?
Pick two search engines and learn how they work.
The difficulty of finding specific information is by far the biggest complaint we hear. Although dozens of search engines are available, pick two, and then take the time to learn

them well. For more on searching read searching the Web. In case you're interested, top choices are Google and Yahoo!.

Choose your own home page.

Both Netscape Navigator and Microsoft Internet Explorer set their respective sites as the default home page when you launch your web browser. If you want to begin your surfing by reading a daily newspaper or better yet, *Learn the Net*, why not start there first? Here's how to select a home page.

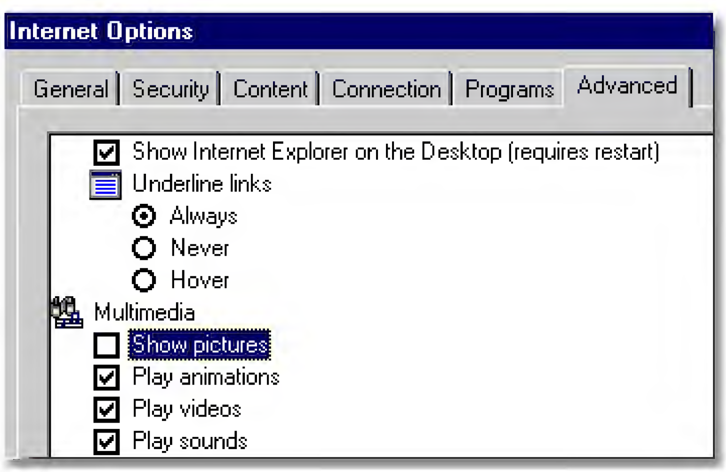
Open a new window.



While you are downloading one web page, you can access another by opening a second browser window. With Navigator, go to the File menu and choose New, then Navigator Window. With Internet Explorer under the File menu select New, then Window. A word of caution: Although you can open multiple windows, this will slow down your computer, so don't go overboard. Remember to close the additional windows to free up disk space.

Surf during off-peak hours.

Most commuters experience rush hour, when highways bog down with traffic. The same phenomenon happens on the Internet--although not as often as in the past--usually in the late afternoon and early evening, when people log on to check e-mail, chat and play games. If you want to avoid the slowdown, go online in the morning or late at night, when traffic is lighter.



View sites in text-only mode.

Sure, web designers spend a great amount of time creating wonderful graphics, but it can take quite a while to download large graphic files. If you must use a slow connection and you want to speed things up, turn off the images in your web browser.

With Internet Explorer 5.0 or later versions, under the Tools menu, select Internet Options, then click the Advanced tab. Now uncheck Show Pictures.

Thoughtful designers will include something called an ALT tag, a written description of the image. If you want to see a particular image, click on the tag with your right mouse button and select View Image. For Mac users, just hold down the mouse button over the graphic. You can also click the Image button in Navigator to load all the images

Connectivity

Phone sets can connect to a PC via Bluetooth or infrared If your PC doesn't support either Bluetooth or Infrared (IR), then you may want to consider buying an adapter that can be plugged into your computer's USB or Serial port. Here is a summary of how to connect your smart phone to your PC.



IR connection.

From the Phone, select 'Connect | Infrared' to turn the phone's IR on. Line up the phone with the PC infrared port, and Windows should detect the handset. Once the PC and handset can see each other, you can either use Windows infrared software to send and receive files, or use the Connectivity Suite supplied with your handset to exchange files, configure or back up your phone. If you don't have infrared, there are several IR adapters available, including the pictured 'USB-IRDA Adapter' from the Market, or the Gerbil serial adapter from Clove.

Bluetooth connection

From the Phone, select 'Connect | Bluetooth'. Turn Bluetooth 'On', and then move to the second tab by moving the joystick to the right. This should show you all Bluetooth devices in range. If your PC isn't shown, select 'Options | New paired device' and let the

phone search for the PC connection. When the phone and PC are paired, use the Nokia Connectivity package to select the file you want to send to the phone. There are several Bluetooth adapters available - take a look at the range offered by **Novatech** .
Software for Symbian OS phones is normally supplied using a Symbian installation file (with a .sis extension). This is a single file that contains the components needed to get a piece of software installed and ready to run. A SIS file can be run on a Symbian phone (e.g. from the Inbox or via a file manager. It can also be run via the PC connectivity solution that was supplied on the CD with the phone. Assuming you have a SIS file on your PC/Mac (either downloaded from the Internet or on a CD), the ways to install a SIS file onto your handset are as follows:

Beaming

Beam the file to your handset from your PC using Bluetooth or IR. If you don't currently have the ability to beam files to the handset via Bluetooth or Infrared (either from another handheld device or from a PC), then you may wish to purchase an IRDA adapter for your PC (this means you'll be able to install software, backup and synchronies data between phone and PC). See the section on IR and Bluetooth for more details.

Install via PC

Assuming you've installed the PC connectivity suite that was supplied with your phone, look for the "Install software" option. You'll need to have the handset connected to the PC via serial, Bluetooth or infrared for this to work.
By email - The alternative, is to email the file that you're trying to install, typically a SIS (Symbian installation file) to your own email account (provided it's a POP or IMAP account, and then use your phone to log on to your email (details) and download the SIS file as an attachment into your phone's Messaging Inbox.

Via memory card

There is another alternative for users of phones that take memory cards (such as the 3650 and 6600) by transferring the SIS file to the handset via the card slot and a PC MMC Memory card reader. Copy files onto an MMC from your PC, and then insert the MMC card into your handset. You'll need to have a file manager on your handset to access the file from the memory card (file managers are available from www.symbos.com). Nokia 7650 does not take memory cards.

Using Infrared

Here is a step-by-step guide for copying a file by infrared:
This assumes you have a Windows PC with infrared hardware, such as a USB-IRDA Adaptor
From the handset, select 'Connect' from the menu, and select 'Infrared'. This turns the phone's IR on.
Line up the phone with the PC infrared port, and Windows should detect the handset. You should see an infrared icon in the system tray. If the PC doesn't find the phone, you need to ensure that infrared is correctly configured on the PC via your PC's control panel (The 'Wireless link' icon).
Once the PC and handset can see each other, you can either use Windows infrared software to send and receive files, or use the Connectivity Suite supplied with your handset to exchange files, configure or back up your handset. We'll assume you're not using the PC Connectivity Suite software, and just want to transfer a file.

Another method of Infrared.

Check that an infrared driver is already installed on the PC. Go to the Windows Control Panel. If the Infrared icon is visible, the driver has been installed. Also check that infrared is enabled on the PC. Note that in Windows 2000 the infrared connection is called *Wireless Link*.
Note: To be able to use an infrared connection with Windows 2000, you must first disable the Image Transfer application in the *Wireless Link* software.
Double-click the PC Suite Connection icon on the taskbar to open the Connection Properties dialog box. Make sure that the correct COM port is selected for the infrared connection. If no port is selected, select the COM port with infrared as the connection type. Note that you can select more than one COM port.

Sending to the PC

Find the file you want to transfer. If the file can't be accessed directly, you may need a file manager (file managers are available from www.symbos.com).
Select the file (e.g. a photo from the Images application), and from the 'Options' menu,

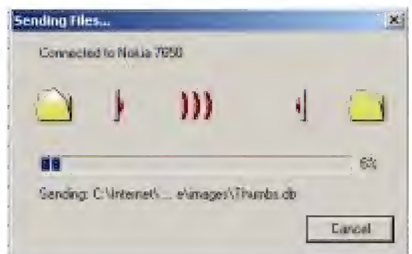


select 'Send', and 'Via infrared'
Windows should start to see the transfer attempt, and should prompt you to receive the file. If you accept the file, the file will be copied to the location specified in the Windows Wireless Link software (or by right-clicking the System tray icon)

Sending a file to the phone

With infrared enabled, right-click the Infrared icon on the system tray and select 'Transfer files'
Select the file you want to transfer from the file browser, and press 'Send'

File transfer should begin, and you should see a transfer dialog



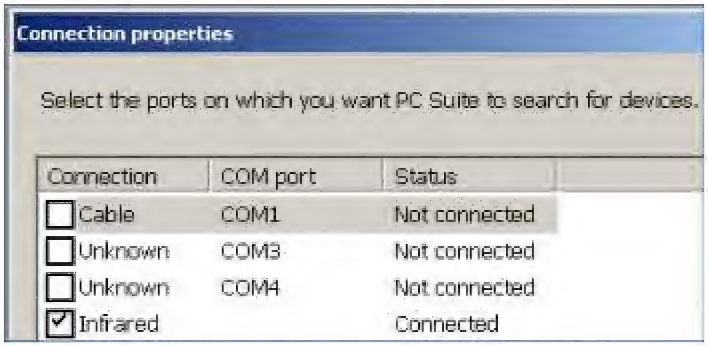
Once received, you can find the file in the Messaging application Inbox. Select the file, and press 'Options' and 'Open.

Setting up the Nokia Connectivity Suite

The Nokia PC Suite needs to be set to talk to the phone on the right COM port. To do this, right-click on the router icon in the system tray next to the clock. Select 'Properties,



and a dialog box will pop up. Make sure that the Infrared box is ticked, and all the others are unticked.



Problems connecting over IR?

General: Having problems? Some general things to look out for:
On the PC, go into Control panel, and check the settings for IR. Make sure you're addressing the right com port and that file transfer is disabled.
Make sure that Infrared is still switched on on the handset (it has a quick timeout)
Nokia PC Suite: If you're having problems connecting your phone to the PC using Infrared with the Nokia Connectivity Suite, start off simply, and try to get basic infrared communication working using the software supplied in Windows, and the software/drivers supplied with your infrared pod. If you can't get basic communication working between the phone and Windows, then chances are, you won't get the Nokia Connectivity Suite to work either. Try a basic file exchange, as detailed above.
Make sure you have no other PC applications loaded that may be set to watch the infrared port (as these may conflict)
Got the latest version of the PC Suite? Get the latest from the concerned vendor i.e. Nokia at http://www.nokia.com/
The PC must have a connection with the phone over IR for the Suite to work, so the system tray icon should show that an IR connection is established (icon of two IR windows beaming data)

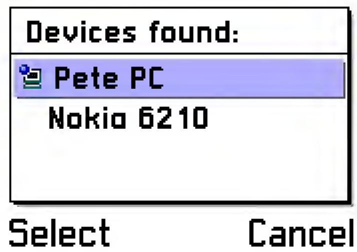
Using Bluetooth

If you want to connect your phone to your PC via Bluetooth, the phone has all the software you need built-in. Your PC will require suitable Bluetooth hardware and software. If your PC isn't Bluetooth-enabled already, the best bet is to get yourself a Bluetooth Adapter to plug into a spare USB port on your PC. There are several Bluetooth adapters available - take a look at the range offered by **Novatech**, or take a look at the Belkin USB Bluetooth adapter
This comes with the required Bluetooth software for your PC.

Here is a step-by-step guide for copying a file via Bluetooth:
This assumes you have a Windows PC with Bluetooth installed hardware, such as a Belkin USB Bluetooth adapter



Before you can make use of a Bluetooth connection between PC and phone, you need to 'pair' them, as follows:
From the phone handset, Go to 'Connect' and select 'Bluetooth'
From the first tab, select 'Bluetooth', and by pressing in the joystick, set Bluetooth to "on"
Move to the second tab, press "Options" and select "New paired device"
Select the device you want to pair with. You'll be prompted to enter a pass code. If the device you're connecting to already has a pass code, then you'll be prompted to add this, otherwise you'll need to create a pass code. Use a number like 1234 (you only need this once to get a pairing, so you don't need to remember it)
You will be prompted to enter the pass code on the device you want to pair to (unless it already has a pass code). Enter the code that matches the one you entered on the phone, and "ok" it.
To allow the phone to always connect without prompting and pairing, you can set the device as "authorized". Do this by selecting the device, and from the options menu, select "Set as authorized".
Once the PC and handset are paired, you can either use the software supplied with your Bluetooth PC hardware to send and receive files, or use the Connectivity Suite supplied with your handset to exchange files, configure or back up your handset. We'll assume you're not using the PC Connectivity Suite software, and just want to transfer a file:
Sending to the PC
Find the file you want to transfer. If the file can't be accessed directly, you may need a file manager (file managers are available from www.symbos.com).
Select the file (e.g. a photo from the Images application), and from the 'Options' menu, select 'Send', and 'Via Bluetooth'. The handset will search for Bluetooth devices in range.



Select the target PC, and the file transfer should begin. If you see "Sending failed", this is most commonly because the PC end is not set up correctly. Each PC Bluetooth adapter comes with different software and settings, so we can't cover every option here - but things to check are that your Bluetooth software has "File Transfer" enabled, that Bluetooth is on, and that there is a default folder defined that received files are placed into.

Sending a file to the phone

The PC is in control of file sending, and as each piece of Bluetooth hardware on a PC comes with different software, we can't provide different step-by-step instructions for all software here. Sending a file is controlled from the PC, and you need to refer to the software supplied with your Bluetooth dongle for how to do this. You'll need to select the file to send, and select from a list of Bluetooth devices in range. As long as the handset's Bluetooth is set to "on" and the handset has been "paired" (see above), then the file should be transferred.

Once received, you can find the file in the Messaging application Inbox. Select the file, and press 'Options' and 'Open.

Another method of CD-Rom Loading.

PC Suites for various phones are in the Install section of company CD-ROM included in the PC Suite phone package. The CD-ROM launches itself automatically after you have inserted it into the CD-ROM drive of your PC. If not, proceed as follows:

Click the Windows Start button, point to *Programs*, and select *Windows Explorer*.

Go to the CD-ROM root directory and double-click the .exe file. The CD-ROM user interface opens.

When the CD-ROM interface is open, proceed as follows:

Click *Install*.

Select *Install now* and click PC Suite for related Mobile i.e. Nokia

Select the language for the installation and click Next to start the installation wizard.

This wizard will guide you through the installation process. Generally, it is

recommended that you accept the suggested destination folder and program folder.
Note: In the *File Transfer Video and Audio Converters* dialog box it is recommended that you leave the *Install Video and Audio Converters* check box selected. When the converters are installed, video and audio format files that you copy from the PC to your phones are automatically converted to the video and audio format used by the phone.

Setting up the Nokia Connectivity Suite (Bluetooth)

Connection is made using "Generic serial". Check your PC Bluetooth software to see which COM port it assigns to "Generic serial", and then from Nokia's Connectivity Suite, make sure that the appropriate COM port is ticked. You'll then need to go into your PC Bluetooth software, and establish Generic Serial link. When the link is established, the Nokia Connectivity Suite should change from "Disconnected" to "Connected"

Connection	COM port	Status
Cable	COM1	Not connected
Cable	COM2	Not connected
Bluetooth	COM7	Not connected
[x] Bluetooth	COM8	Connected
Bluetooth	COM9	Not connected

Another method of Bluetooth.

Before you can connect your phone to the PC via Bluetooth for the first time, you must have provided a name for your phone to be used in a Bluetooth connection. For instructions on giving a name to your phone, to make your phone discoverable and connectable. Go to Connectivity and select Bluetooth. Then select Bluetooth On. To make your phone discoverable, change my phone's visibility to Shown to all in the Bluetooth menu.

To establish a Bluetooth connection:

Make sure that a Bluetooth card is inserted in the PC card or Compact Flash (CF+) slot and that the software provided with the Bluetooth card is installed on the PC, or check that your PC includes built-in support for Bluetooth. A serial port profile must exist for the Bluetooth card on the PC.

Establish a serial port connection between your phone and your PC.

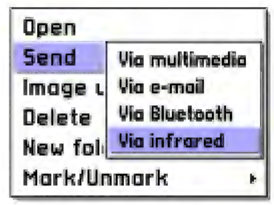
Double-click the PC Suite Connection icon on the taskbar to open the Connection Properties dialog box. Make sure that the correct port is selected for the Bluetooth connection. If no port is selected, select the COM port with Bluetooth as the connection type. Note that you can select more than one COM port.

Down loading & Uploading

Ring Tones

7650 and 3650 supports playback of .mid or .wav files, and use of these file formats as ring tones. To use such a sound file, beam or email the file to your handset. It will then appear in the Messaging Inbox. Open the message and select 'Options | Save'. Then, from 'Profiles', select a profile and set the 'Ringing tone' to the new file.

Pictures sharing



Once you have taken a picture on your smart phone, there are three ways to get the files from your phone to other people or computers:

You can copy it to your PC with the Nokia software supplied on the CD. Depending on what you have connected to your computer, you can use Infrared or Bluetooth. Set your PC to receive files (using the IR or Bluetooth software supplied with your adapter), select the photo to send (from Images), then from the Options menu, select Send.

You can use the Messaging application and email the picture to yourself (or a friend)

Send the picture to another mobile using MMS. Costs of sending pictures by MMS differ depending on which network operator you're with. Take a look at our MMS page for more.

Alternative connectivity software

Rather than the software that came as standard with the phone, there's a rather useful third-party application called **Oxygen II** - This application supports Contacts, Calendar, Messaging and file management.

Sending other file types to a PC

As above, Series 60 handsets support "Send via" as a way of sending a file by infrared, Bluetooth, e-mail, or as a multimedia message. This works fine for recognized file types, but it could be that you want to copy different types of files to your PC. To do this, you'll need a file manager that

lets you browse through all of the folders on your handset, and select a file to beam off. The most respected file manager around is Symbianware's **FileManager**, which can be downloaded from **www.symbos.com**

Theory Exercise

Answer the following questions

1. What is meant by netsurfing?
2. How you can enhance your netsurfing skills?
3. What is PC-Mobile connectivity means?
4. What the most common techniques of connectivity?
5. What is the function of Infrared?
6. What is Bluetooth technology means?
7. What are the common known data cables available in the market?
8. What is meant by PC suits?
9. How we connect a Mobile to a computer?
10. How we can down load and up load ring tones, games & songs in a Mobile from computer?

Fill in the blank.

1. 56 Kbps modem has been replaced with a high-speed service such as --------------.
2. Cable modem increase ------------- speed
3. ---------- needs a driver installed on the computer
4. Bluetooth should be active on both ---------- and on -----------.
5. ------------are most cheaper way to connect to the computer.
6. New generation Mobile phones only providing --------- facilities to connect to PC.

Write True / False.

1. *Nokia 7650 and 3650 handset do not support cable, serial or USB connections*
2. Infrared is software device
3. Bluetooth is Hardware device
4. Ring tones are in compressed form in the computer.
5. Every mobile set has the option to install ring tones and games
6. Infrared is integrated in most mobile sets.

Practical Exercise-1

Topic	**Installation of Mobile PC suit on the Computer.**
Findings	

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-I1

Topic	**Installation of Infrared and Bluetooth driver kit on Computer.**

Findings

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-II1

Topic	**Mobile to PC connectivity via IR.**

Findings

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-IV

Topic	**Mobile to PC connectivity via Bluetooth and data cable.**

Findings

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-V

Topic	**Loading and uploading of Ring tones , Mobile games on the mobile phones.**

Findings

Instructor Remarks	
Instructor Signature	Trainee Signature

Practical Assignment-VI

Topic	**Software trouble shooting**

Findings

Instructor Remarks	
Instructor Signature	Trainee Signature

TIPS, SECRETS, FAQs

Unlocking Mobile Phones

Software is available on the CD Rom that needs to be installed for proper demonstration.

Codes

Samsung Phones

*#06# -> Show IMEI
*#9999# -> Show Software Version
*#0837# -> Show Software Version (instructions)
*#0001# -> Show Serial Parameters
*#9125# -> Activates the smiley when charging.
*#9998*228# -> Battery status (capacity, voltage, temperature)
*#9998*246# -> Program status
*#9998*289# -> Change Alarm Buzzer Frequency
*#9998*324# -> Debug screens
*#9998*364# -> Watchdog
*#9998*377# -> EEPROM Error Stack - Use side keys to select values. Cancel and ok.
*#9998*427# -> Trace Watchdog
*#9998*523# -> Change LCD contrast - Only with version G60RL01W
*#9998*544# -> Jig detect
*#9998*636# -> Memory status
*#9998*746# -> SIM File Size
*#9998*778# -> SIM Service Table
*#9998*785# -> RTK (Run Time Kernel) errors - if ok then phn is reset, info is put in memory error. *#9998*786# -> Run, Last UP, Last DOWN
*#9998*837# -> Software Version
*#9998*842# -> Test Vibrator - Flash the screenligth during 10 seconds and vibration activated.
*#9998*862# -> Vocoder Reg - Normal, Earphone or car kit can be selected
*#9998*872# -> Diag

*#9998*947# -> Reset on Fatal Error
*#9998*999# -> Last/Chk
*#9998*9266# -> Yann debug screen (=Debug Screens?)
*#9998*9999# -> Software version
*0001*s*f*t# -> Changes serial parameters (s=?, f=0,1, t=0,1) (incomplete)
0002?# -> unknown
0003?# -> unknown
*2767*3855# -> Full EEPROM Reset (THIS CODE REMOVES SP-LOCK!!)
But also changes IMEI to 447967-89-400044-0,
To restore your old IMEI use the IMEI program found on the software page.
*2767*2878# -> Custom EEEPROM Reset
These codes has been tested with version FLD_2C6 G60SB03X of Samsung SGH-600

NOKIA

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#170602112302# shows the SW version.
Latest software version on Nokia 1610: v 5.15 (25.02.97) NHE-5NX - older versions V 4.19
Latest software version on Nokia 1611: V 4.03 NHE-5SX

Nokia 2010

To view IMEI number *#06#
To view Software Version enter *#9999#

Nokia 3210

*#06# for checking the IMEI (International Mobile Equipment Identity) Information you get from the IMEI:

XXXXXX XX XXXXXX X

TAC FAC SNR SP

TAC = Type approval code

FAC = Final assembly code
SNR = Serial number
SP = Spare
*#0000# to view Software Version.
#746025625# [*#sim0clock#]
Checks if the sim clock can be stopped. Sim clock stop is a kind of stand-by mode which will save battery time. This code doesn't work with software version 4.59.
#92702689# [#war0anty#] takes you to a secret menu with 6 choices:

1. Displays Serial Number.
2. Displays the Month and Year of Manufacture (0997)
3. Displays (if there) the date where the phone was purchased (MMYY)
4. Displays the date of the last repairment - if found (0000)
5. Makes you capable of transferring user data if you have the gear for it
6. Shows how many hours the phone has been on

Latest software version: V 5.02 NSE-8/9
V.4.41 NSE-8/9 (17-08-99)0
V 4.11 (???)
V 3.10 NSE-8
*#3370# - Enhanced Full Rate Codec (EVER) activation. It will automatically restart.
#3370 - Enhanced Full Rate Codec (EFR) deactivation. It will automatically restart.
*#4720# - Half Rate Codec activation. It will automatically restart
#4720 - Half Rate Codec deactivation. It will automatically restart
Enhanced Full Rate will give you much better sound quality when you enable it. The new Enhanced Full Rate CODEC adopted by GSM uses the ASLEEP (Algebraic Code Excitation Linear Prediction) compression technology. This technology allows for much great voice quality in the same number of bits as the older Full Rate CODEC. The older technology was called LPC-RPE (Linear Prediction Coding with Regular Pulse Excitation). Both operate at 13 kilobits. (But you take up more space on the network, so they can charge you more) - Talk-time is reduced with about 5%

Nokia 3810

To view IMEI number *#06#
To view Software Version enter *#3810#

Nokia 6080 / 6081

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#0000# shows the SW version.
Latest software version on 6080 V 4.80 NHE-2
Latest software version on 6081 V 5.14 NHE-2A

Nokia 6120 / 6160 / 6162 (TDMA phones)

*#92772689# for checking ISDN number.
*3001#12345# for field test mode and name selection and some other stuff...
*#9999# shows the SW version.

Nokia 6150

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#0000# shows the SW version.
*#92702689# to enter service menu.
Latest software version 5.22 (10-11-99) NSM-1
Older versions:
5.20 (20-09-99) NSM-1
5.17 (01-07-99) NSM-1
Updates:

1. Updated GSM-list
2. *4720# and #4720# (activate/deactivate Half rate) doesn't work anymore!
3. New menu option: 4-4-6 Confirm SIM service actions Lets you select whether SIM service actions are visible and confirmed by you.
4. Automatic menu-language selection doesn't work anymore!

V 5.02 (02-02-99) NSM-1
V 4.13 NSM-1 (EFR option should be back in this version)
V 4.12 NSM-1 (EFR option removed in this version)
V 4.11 NSM-1 (EFR option removed in this version)
V 4.02 NSM-1

Nokia 6190

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#6190# shows the SW version.

*#92772689# (after removing the analog module) shows service menu.
*3001#12345[OK] to enter test mode.
*#639# to change NAM.

Nokia 7110

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#0000# to view Software Version.
*#3370# - Enhanced Full Rate Codec (EFR) activation. It will automatically restart.
#3370 - Enhanced Full Rate Codec (EFR) deactivation. It will automatically restart.
*#4720# - Half Rate Codec activation. It will automatically restart
#4720 - Half Rate Codec deactivation. It will automatically restart
*#746025625# - Sim clock allowed status.
#92702689# [#war0anty#] - takes you to a secret menu with 6 choices:

1. Displays Serial Number.
2. Displays the Month and Year of Manufacture (0997)
3. Displays (if there) the date where the phone was purchased (MMYY)
4. Displays the date of the last repairment - if found (0000)
5. Makes you capable of transferring user data if you have the gear for it
6. Shows how many hours the phone has been on

Latest software version: 4.77 25-01-00 NSE-5 - EFR and half rate codes do not work with this version.
V 4.76 13-01-00 NSE-5
V 4.75 07-01-00 NSE-5
V 4.73 15.11.99 NSE-5

Nokia 8850

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#0000# to view Software Version.
Latest software version: V 5.11 09-12-99 NSM-2
Older version: V5.08

Nokia 9000/9000i

To view IMEI number *#06#

To view Software Version enter *#8110# Latest Version is under Phone Info.
To view Week and Year of manufacture enter *#3283#

Nokia 9110

*#06# for checking the IMEI (International Mobile Equipment Identity)
*#0000# shows the SW version.

Motorola

MOTOROLA 6200 / 7500 / 8200 / 8400 / 8700

To activate RBS (Engineering Menus):
[Pause] [Pause] [Pause] 1 1 3 [pause] 1 [pause] [ok]
(Pause means the * key held in until box appears)
You now have to press the [MENU] and scroll to the
'Eng Field Options' function with the < or > keys, and enable it.
To de-activate RBS (Engineering Menus):
[Pause] [Pause] [Pause] 1 1 3 [pause] 0 [pause] [ok]
(Pause means the * key held in until box appears)
Works on 6200's,8200's,1-888's,7500's,8400's and GSM StarTacs
with later than version .27 software.
Options under Eng Field Options
Eng Field Options
Active Cell
RxLev -55Received power level in dBm
NCC 0National Colour Code, used for identifying channel
BCC 7Broadcast Colour Code, also for identifying purposes
MSTxPwr 35Max allowed transmit power 35dBm about 3.2W
Time Adv xxxxxx is a number. Multiply this number by 550, and the result is the distance from the RBS (Radio Base Station), in meters.
Adjacent Cells
Adj Cell 1
Channel 0033Channel Number
RxLev -65Received power level in dBm

BACH Decode thinks it means it is able to decode the channel information contained in the BACH
RxLevAM -104Min allowed reception, compare with RxLev -65 and you get the C1 value which is 39 and reported back to base as measure of field strength.
MTxPwr 35 Aain max allowed power level
C1 003??
NCC 0 National Colour Code
BCC 6 Broadcast Colour Code
System Parameters
Combined Off??
AcsClas 0000 allows different priorities - this network doesn't support it.
MCC 505 Mobile Country Code, 505 for Australia, 240 for Swedes etc
MNC 01Mobile Network Code, 01 for Mobile net, 02 for Optus, 03 for Vodafone using MCC 505. MCC+MNC is often called Network Code
LAC 08720Location Area Code, shows which exchange you're in
CellID 00473Base Station Identity
T3212 005Time between periodic network updates (either hours between or time reaming until update, not sure)
BS-PA-MFRM 4??
XZQTY 14.3??
Motorola Flip Pin out:
ANT- (O) | | | | | | | | | |
10 9 8 7 6 5 4 3 2 1
Top of phone (screen)

1) Audio Ground
2) Ext b+
3) T Data
4) C Data
5) R Data
6) Logic Ground
7) Audio Out - on/off
8) Audio In
9) Manual Test
10) Battery Feedback

Motorola MICRO-TAC "FLIP" SERIES

This phone follows similar methods as outlined for the 8000 series above.
Remove the battery and locate the three contacts at the bottom of the phone, the two outer contacts are raised and connect with the battery. The center contact is recessed, this is the Manual Test Mode connector.
Now look at the battery contacts, the two outer ones supply power to the phone, the center contact is an "extra" ground. This ground needs to be shorted to the test mode connector on the phone. The easiest way to do this is to put a small piece of solder wick, wire, aluminum foil or any other conductive material into the recess on the phone. Having done this carefully replace the battery and turn on the power, if you have been successful the phone will wake up in test mode.

Test Mode Programming

Assuming you have completed one of the above steps correctly the phone will wake up in test mode when you turn the power on. When you first access test mode the phone's display will alternate between various status information that includes the received signal strength and channel number. The phone will operate normally in this mode. You can now access Service Mode by pressing the # key, the display will clear and a ' will appear. Use the following procedure to program the phone:

1. Enter 55# to access programming mode.
2. The * key advances to the next step. (NOTE that test mode programming does NOT have step numbers, each time you press the * key the phone will display the next data entry).
3. The CLR key will revert the display to the previously stored data.
4. The # key aborts programming at any time.
5. To complete programming you must scroll through ALL entries until a ' appears in the display.
6. Note that some entries contain more digits than can be displayed by the phone, in this case only the last part of the data can be seen.

Test Mode Programming Data

STEP# #OF DIGITS/RANGE DESCRIPTION

1. 00000 - 32767 SYSTEM ID
2. 8 DIGIT BINARY OPTION PROGRAMMING, SEE NOTE 1 BELOW

3. 10 DIGITS MIN (AREA CODE & TEL#)
4. 2 DIGITS STATION CLASS MARK
5. 2 DIGITS ACCESS OVERLOAD CLASS
6. 2 DIGITS GROUP ID (10 IN USA)
7. 6 DIGITS SECURITY CODE
8. 3 DIGITS LOCK CODE
9. 3 DIGITS SERVICE LEVEL (LEAVE AT 004)
10. 8 DIGIT BINARY OPTION PROGRAMMING, SEE NOTE 2 BELOW
11. 8 DIGIT BINARY OPTION PROGRAMMING, SEE NOTE 3 BELOW
12. 0333 OR 0334 INITIAL PAGING CHANNEL
13. 0333 "A" SYSTEM IPCH
14. 0334 "B" SYSTEM IPCH
15. 3 DIGIT NUMBER PAGING CHANNEL (021 IN USA)
16. 8 DIGIT BINARY OPTION PROGRAMMING, SEE NOTE 4 BELOW

Steps 1 through 6 and 12 will repeat for NAM 2 if the second phone number bit has been enabled in step 11.

NOTES

Take care with Motorola's use of "0" and "1". Some options use "0" to enable, some use "1".
These are eight digit binary fields used to select the following options:

1. (step 02 above, suggested entry is: 11101001 for "A" system, 10101001 for "B" sys)

- Digit 1: Local use mark, 0 or 1.
- Digit 2: Preferred system, 0 or 1.
- Digit 3: End to end (DTMF) dialing, 1 to enable.
- Digit 4: Not used, enter 0.
- Digit 5: Repertory (speed) dialing, 1 to enable.
- Digit 6: Auxiliary (horn) alert, 1 to enable.
- Digit 7: Hands free (VSP) auto mute, 1 to enable (mutes outgoing hands free audio until the MUTE key is pressed).
- Digit 8: Min mark, 0 or 1.

2. (step 10 above, suggested entry is: 00000100)

- Digits 1 - 4: Not used in Pakistan, enter 0.

- Digit 5: Single system scan, 1 to enable (scan A or B system only, determined by bit 2 of step 02. Set to "0" to allow user the option).
- Digit 6: Super speed dial, 1 to enable (pressing N, or NN SND will dial the number stored in memory location NN).
- Digit 7: User selectable service level, 0 to enable (allows user to set long distance/memory access dialing restrictions).
- Digit 8: Lock function, 0 to enable (allows user to lock/un-lock the phone, if this is set to 1 the phone can not be locked).

3. (step 11 above, suggested entry is: 00000000)

- Digit 1: Handset programming, 0 to enable (allows access to programming mode without having to enter test mode).
- Digit 2: Second phone number (not all phones), 1 to enable.
- Digit 3: Call timer access, 0 to enable.
- Digit 4: Auto system busy redial, 0 to enable.
- Digit 5: Speaker disable, 1 to enable (use with select VSP units only, do not use with 2000 series mobiles).
- Digit 6: IMTS/Cellular, 1 to enable (rarely used).
- Digit 7: User selectable system registration, 0 to enable.
- Digit 8: Dual antennae (diversity), 1 to enable.

4. (step 16 above, suggested entry is: 0011010 for portable and 0011011for mobile units)

- Digit 1: Not used, 0 only.
- Digit 2: Not used, 0 only
- Digit 3: Continuous DTMF, 1 to enable (software version 8735 and later)
- Digit 4: 8 hour time-out, 0 to enable (software version 8735 and later)
- Digit 5: Not used, 0 only.
- Digit 6: Failed page indicator, 0 to enable (phone beeps when an incoming call is detected but signal conditions prevent completion of the call).
- Digit 7: Portable scan, 0 for portable, 1 for mobile units.

C-SCAN OPTION

Newer Motorola phones are equipped with a feature called C-Scan, this is an option along with the standard A/B system selections. C-Scan allows the phone to be programmed with up to five inhibited system ID's per NAM. This is designed to prevent

the phone from roaming onto specified non-home systems and therefore reduce "accidental" roaming fees.

1. C-Scan can only be programmed from test mode, power phone up with the relevant test mode contact grounded (see above).
2. Press # to access test mode.
3. Press 18#, the phone will display "0 40000".
4. Enter the first inhibited system ID and press *
   Continue to enter additional system ID's if required. After the 5th entry the phone will display "N2". Press * to continue and add system ID's for NAM 2 as required.
5. If an incorrect entry is made (outside the range of 00000-32767) the display will not advance, press CLR and re-enter. Use a setting of 40000 for any un-needed locations.
6. When the last entry has been made press * to store and press # to exit, turn off power.

LOCK/UNLOCK PROCEDURES

Phones with "LOCK" buttons: Press lock for at least 1/2 a second.
Phones with a "FCN" button: Press FCN 5, note that 5 has the letter's "J,K, and L" for lock.
Phones with no FCN or LOCK button: Press Control 5, control is the black volume button on the side of the handset.

SYSTEM SELECT PROCEDURES

Phones with a RCL button: Press RCL *, then * to select, STO to store.
Phones with no RCL button: Press Control * then * to select, # to store.
Options are: CSCAn: Preferred/Non preferred with system lockout.
Std A/b, or Std b/a: Preferred/Non preferred.
Scan Ab, or Scan bA: Non preferred/Preferred
Scan A: "A" ONLY
Scan b: "B" ONLY
HOME: Home only
(These are typical options, some phones vary. C-Scan only available on newer models and does not appear unless programmed, see above

GENERAL NOTES

HANDSETS: Most Motorola handsets are interchangeable, when a handset is used with a transceiver other than the one it was designed for the display will show "LOANER". Some features and buttons may not work, for instance if the original handset did not have a RCL or STO button, and the replacement does, you will have to use the control * or control # sequence to access memory and A/B system select procedures.

MOTOROLA TEST MODE COMMANDS

01# RESTART (POWER OFF THEN ON)
02# STATUS DISPLAY ALTERNATES BETWEEN:
ABC DEF where:
ABC = Channel number
DEF = Received sensitivity for that channel
and: A B C D E F G where:
A = SAT frequency (0=5970, 1=6000, 2=6030, 3=no channel lock)
B = Carrier (0=off, 1=on)
C = Signaling tone (0=off, 1=on)
D = Power level (0 through 7)
E = Channel mode (0=voice channel, 1=control channel)
F = Receive audio mute (0=unmated, 1=muted)
G = Transmit audio mute (0=unmated, 1=muted)
Press * to hold display and # to end.
03# Reset call timers
04# Initialize Transceiver to following settings:
Carrier = OFF
Receive Audio = MUTED
Transmit Audio = MUTED
Signaling Tone = OFF
Call Timer RESET and periodic resetting ENABLED
SAT = OFF
DAM & Audio Tones = OFF
Audio Path = To SPEAKER
05# Turn Carrier ON
06# Turn Carrier OFF
07# Mute RECEIVE audio

08# Unmute RECEIVE audio
09# Mute TRANSMIT audio
10# Unmute TRANSMIT audio
11ABC# Load Synthesizer with ABC, where ABC=the channel number in decimal
12A# Set RF power level to A, where A=1 to 7
13# Power down phone
14# Transmit signaling tone
15# Stop transmit of signaling tone
16# transmit a five word reverse voice channel message, all words will be: "FF00AA55CC33"
17# transmit a two word reverse voice channel message, both words will be: "FF00AA55CC33"
18# Display contents of NAM one address at a time, press * to advance, press # to exit. (Two digit numbers to the left is the ADDRESS, to the right is the DATA)
19# Display software version
20# Receive control channel messages counting correctable and uncorrectable errors. When the command starts the number of the command will be displayed in the upper right hand corner of the display. Entering# will terminate the test and display two three digit numbers. The first number is the number of correctable errors and the second is uncorrectable errors.
21# Receive voice channel messages counting correctable and uncorrectable errors. When the command starts the number of the command will be displayed in the upper right hand corner of the display. Entering# will terminate the test and display two three digit numbers. The first number is the number of correctable errors and the second is uncorrectable errors.
22# Receive control channel messages counting word sync sequences. When the command starts the number of the command will be displayed in the upper right hand corner of the display. Entering# will terminate the test and display the number of word sync sequences in the display.
23# Receive voice channel messages counting word sync sequences. When the command starts the number of the command will be displayed in the upper right hand corner of the display. Entering a # will terminate the test and display the number of word sync sequences in the display.
24# Turn SAT transmission ON
25# SAT OFF

27# Transmit continuous control channel data, all words are: "FF00AA55CC33". When the command starts the number of the command will be displayed in the upper right hand corner of the display. Press # to terminate the test.
28# Activate high tone (1150 Hz +/- 55 Hz)
29# Deactivate high tone
30# Activate low tone (770 Hz +/- 40 Hz)
31# Deactivate low tone
32# initialize all non-volatile memory to zeros. Resets unit and makes it look "new".
33A# Activate DTMF tone where A = DTMF digit 0 thru 9
34# Deactivate DTMF
35A# Send audio path to A where A = 0 for hands free, 1 for speaker, 2 for alert, 3 for Handset
36ABC# Activate channel scan, ABC is scan speed in milliseconds. Tunes from channel 1 to 666. Press * to pause scan and display RSSI, if scan speed is 300 milliseconds or greater the RSSI is displayed with each channel, if scan is less than 300 milliseconds the RSSI is only displayed when you press *
37# not used
38# Display serial number in hex (ESN). Displays the byte number in the upper right side of the display and the data to the left, press * to step through the bytes, press # to exit.
39# Receive one control channel word, when the word is received it will be displayed in hex. Command terminates when the word has been received or when # is pressed.
40# Receive one voice channel word, when the word is received it will be displayed in hex. Command terminates when the word has been received or when # is pressed.
41# (F19CTA models only) enables the diversity antenna option on mobiles so equipped.
42# Disable diversity.
43# Disable diversity and force the mobile to use the TRANSMIT antenna.
44# Disable diversity and force the mobile to use the RECEIVE antenna.
45# Display the RSSI reading taken on the current channel.
46# Display the cumulative call timer.
47A# Set audio level to A where A = 0 lowest, A = 6 highest, or A = 7 muted.
48# Turn side tone on
49# Side tone off
50# Maintenance data is transmitted and test results displayed: PASS =Received data is correct, FAIL1 = No data received within 2 seconds, FAIL2 = Received data is incorrect.
51# Maintenance data is transmitted and looped back and test results displayed: PASS = Looped back data is correct, FAIL1 = No data looped back within 2 seconds, FAIL2 = Looped back data is incorrect.

52A# Set phase adjustment. A decimal number that corresponds to phase shift compensation in 4.5 degree increments. Compensation added to the inherent phase shift of the transceiver to achieve a total phase shift of 0 (zero) degrees. Do not enter any value other than from the following list:

entered, Degree of shift
0 0 59 121.5 86 243.0
1 4.5 60 126.0 87 247.5
2 9.0 61 130.5 112 252.0
3 13.5 62 135.0 113 256.5
4 18.0 63 139.5 114 261.0
5 22.5 40 144.0 115 265.5
6 27.0 41 148.5 116 270.0
7 31.5 42 153.0 117 274.5
16 36.0 43 157.5 118 279.0
17 40.5 44 162.0 119 283.5
18 45.0 45 166.5 120 288.0
19 49.5 46 171.0 121 292.5
20 54.0 47 175.5 122 297.0
21 58.5 64 180.0 123 301.5
22 63.0 65 184.5 124 306.0
23 67.5 66 189.0 125 310.5
48 72.0 67 193.5 126 315.0
49 76.5 68 198.0 127 319.5
50 81.0 69 202.5 104 324.0
51 85.5 70 207.0 105 328.5
52 90.0 71 211.5 106 333.0
53 94.5 80 216.0 107 337.5
54 99.0 81 220.5 108 342.0
55 103.5 82 225.0 109 346.5
56 108.0 83 229.5 110 351.0
57 112.5 84 234.0 111 355.5
58 117.0 85 238.5

53# Enable scrambler option, if equipped.
54# Disable scrambler option, if equipped.
55# Test Mode programming.
58# Compandor on. Audio compressor and expander on.
59# Comprador off. Audio compressor and expander off.

61# Serial number transfer, not all models.
62# turn on audio ringer path.
63# turn off audio ringer path.
70# Abbreviated field transmitter audio deviation command for transceivers with FCC ID: ABZ89FT5668.
71# Abbreviated field power adjustment command for transceivers with FCC ID: ABZ89FT5668.
72# Field audio phasing command.
73# Field power adjustment command.

Siemens

SIEMENS S1 / S3 / S3 COM / S4

To view the software date and else with S3 com, S4, S4Power
press with SIM removed *#06# and left soft key.
To view some other stuff with S4Power
press with SIM removed *#06# and left soft key twice.
To view the software date with S3 com, S4, S4Power
press with SIM installed menu 98 and left soft key twice.

ACTIVATE MONITOR MODE

Siemens S1/S3

Menu, 9 (Phone Options), 7 (Phone Status), Left Display Button (left MENU key), 5553756, Hang-Up Button (Red Handset key)

Siemens S3 COM/S4

Menu, 9 (Phone Options), 7 (Phone Status), Left Display Button
(Left MENU key), 7684666, Hang Up Button (Red Handset key)
Note: Now Monitor should appear at the bottom of the Network Options menu.

MONITOR MODE

Pressing the right Display Button when in monitor mode will toggle into 1 and 2 modes .Pressing the right Display Button when in monitor mode will show a
List of the six cells with the strongest signals.
Test Mode Indicators: (* = only available when call in progress)
CH Channel Number
RX Signal Strength (dB)
N NCC (Colour Code)
B BCC (Colour Code)
CI Cell ID (in Hex)
C1+ How long before phone does forced hand over. (See RX and RXAM)
LAI Location Area Identity. Display Network ID code (42F010 = 240.01) and MSC
TXPWR Transmit Power (dB)
RXAM Receive signal strength cut-off point
TS* Time Slot Number
TA* Timing Advance. Distance from tower in Km X 2
PL* Power Level

SIEMENS S1

Here's a trick to play Tetris, also known as Klotz on a Siemens S1.
Turn the phone on. Enter PIN. Before the telephone has logged in to the
your GSM net do the following steps.

1. Choose F 9 (function settings)
2. Choose send own number and push the right button for choose.
3. Push 9

USE 2 as < and 8 as > , rotate the klotz with 5 and drop with 4.
I have just heard from one of the programmers of the phone that Tetris
was in the phone during development, but it was removed before it was produced. Apparently someone has the patent on games in mobile phones and Siemens didn't want to pay the licensing fees. It was either in Menu F-9-9 or it's not there at all.

Chapter 9

FAQ

What is GSM?

GSM (Global System for Mobile Communications) is the world's predominant mobile phone standard, first adopted in Europe and then quickly spreading throughout Asia, Africa and the Pacific Rim (Australia, N. Zealand, etc.). GSM enables the same cell phone to work in London, Johannesburg, Beijing, Sydney and elsewhere.

The United States however, did not standardize GSM as a part of its infrastructure, instead leaving the development of cellular service to competing wire carriers which created whatever standard they wished including CDMA and TDMA. Only recently has the US aggressively embraced the GSM standard, which makes the Cellular Abroad service that much better.

What is a SIM card?

The SIM (Subscriber Identity Module) card also known as a "smart chip" is basically the "brain" of the phone, providing cellular service as well as many other functions including call log, voice mail and SMS and GPRS (internet connection standards). SIM cards are the size of a credit card but they have a pop-out chip about the size of a postage stamp which fits into all modern GSM phones. The smart chip is embedded with circuitry and when inserted into a GSM mobile phone provides wireless phone service on a particular GSM network. SIM cards are usually available prepaid or on a contractual basis, however Cellular Abroad only offers the prepaid version which is the most popular because of the user's complete control over how much they spend. There are no hidden fees or surprise charges.

Is this like a calling card?

Not really. You cannot receive a call with a calling card. Calling cards are a bit risky and often provide poor customer service. With the increasing popularity of mobile phones, it is not uncommon to find broken pay phones that go un repaired by companies that own them.

I currently have a GSM Phone. Will it work overseas?

It is possible, though unlikely, that your current US GSM cell phone will work overseas. Most GSM phones sold in the US are only compatible with the nation-wide operating frequency of 1900 MHz (or the emerging 850MHz band). Overseas services use 900 and/or 1800 MHz frequency standards, which is why we carry only (unlocked) tri-band phones. Most carriers offer global tri-band phones, however they provide them "locked" which is a distinct disadvantage for the consumer.
All GSM cell phones sold through Cellular Abroad are unlocked and ready to use on practically all GSM networks and with all SIM cards. At Cellular Abroad we believe in freedom of choice for our customers in order to provide the best possible price on airtime and network service. Most other plans force you to use one system with no control over airtime pricing or the lowest rates available.

What is a locked cell phone?

A locked cell phone is one that has been altered in order to use only one particular cellular network. This is often referred to as a service provider lock or "SP lock" for short. All GSM network operators lock the GSM cell phones they sell or offer with their cellular services. This is the hidden cost of the otherwise "free" or heavily-discounted phone you might receive directly from a network operator by signing a service contract. The cost of providing you with a "free" or low cost phone is subsidized over time through more expensive phone rates when you make calls domestically or roaming overseas. In the end, you end up paying much more for your "free" phone and service than you would if you purchased a package through Cellular Abroad and had the rock-bottom prices available everywhere. An unlocked phone is therefore one where this software restriction has been removed.

How is the cellular coverage in other countries?

Generally speaking, cellular coverage overseas is excellent. Cellular usage is more common overseas than it is in the Pakistan and the GSM standard is a higher quality than many of the technologies available domestically. One point to make, however, is that buildings in cities are sometimes many hundreds of years old. Thus they have much thicker walls than relatively modern architecture, so if you are indoors and away from a window, you may have difficulty getting reception.

What are PIN and PUK numbers?

Some prepaid SIM cards have a security mechanism in place that requires the subscriber to enter in a PIN (personal identification number) code every time the GSM cell phone is turned on. When a PIN code has been assigned it is important not to forget this code. If you enter the PIN code incorrectly into the phone 3 times in a row then your GSM cell phone will display a Blocked message on its LCD. When this occurs you will then be required to unblock your phone using the PUK code. If you enter the PUK phone incorrectly 10 times in a row you will block your SIM card indefinitely. All phones have a different set of procedures to unblock and you will need to consult your GSM cell phone manual when this occurs. We strongly suggest that if you have the PIN-check feature enabled on your SIM card that you turn it off. Please consult your phone manual's index under the "security" or "lock" section if unsure how to disable PIN-check.

Is it better to buy or rent the phones from you?

There is no simple answer for this. If your rental period approaches 2 months, you would be better off buying the phone. Also, if you travel often, it makes sense not having to keep paying for shipping. Renting a phone is a good way to try out our phone and see if you like it. If you decide to keep the rental, you pay no rental fee. You simply forfeit the deposit on the phone. On the other hand, purchasing a phone ensures you will be acquiring an unused handset.

How can I be sure the technology won't become obsolete in the future?

This certainly won't occur in the near future. In fact, this is a relatively new technology in the Pakistan that many of the cellular service providers are quickly embracing. Sure, there will always be newer, smaller and "better" cell phones introduced in the future, but the underlying technology powering the service will remain the same. Consider classic cars as an analogy; while they may be less modern, they still get you around because even the oldest vehicles use gasoline for power.

How many minutes come with the SIM card?

The SIM cards usually come with call credits measured in monetary units such as euros rather than increments of time. This is because rate charges for calls vary depending on time of day, destination of the calls and other discounts or charges the carrier may apply. Also, with most GSM carriers providing free incoming calls to the user, the number of minutes on the SIM card could be substantial without the need to add more call credits.

If the SIM card costs Rs300/-, do I get Rs300/- worth of talk time?

When you purchase the prepaid SIM card, you are buying the brain that inserts into your GSM cell phone and makes it work. There is always some credit included with new SIM cards, but the amounts vary from country to country. Additional airtime is purchased locally and usually available at or near face value. For example, a Rs:500.voucher will credit your SIM card 500 Rupees. The remaining cost for the SIM card is a set-up fee which pays for service on this particular pre-paid account.

What are the calling rates?

Rates vary from country to country whether you are utilizing a country-specific or international SIM card. Please check the exact rates by visiting our Pre Paid SIM Cards page and clicking on the link for the appropriate country-specific provider. With the exception of just a few countries, incoming calls (received within-country) for the country-specific SIM cards are always FREE— regardless of origin.

How do I calculate my rental period?

It is important to remember that your phone rental is measured from the time that the phone leaves our offices until the time it is sent back (not when it arrives) or returned in person. We use some tracking information to document this period of time for shipped phones. The number of days the rental is out between these two ship times will be rounded up or down to the closest weekly rental period.

After my trip, could I use the phone I buy from Cellular Abroad at home?

All of the phones we sell work on the 1900 MHz GSM band, which is the standard in the Pakistan. While GSM technology is the world standard for mobile phone communications, you may find that your local GSM provider has poor coverage in your area. We at Cellular Abroad cannot determine this information for you. Your best bet is to ask people you know who use a GSM carrier in your area and see what their experience has been. You will also want to check directly with the GSM carrier you want to use to find out their rate plans. Inform them that you will have an unlocked 1900 MHz GSM phone already and find out what's involved in integrating that phone with their service.

Will my phone come with a charger?

Yes! All of our cell phones (for rent or for sale) come with a variable-voltage travel charger plus wall-plug adapters for overseas. Our rental phones are shipped pre-charged.

What is my new cell phone number?

Your new cell phone number is a local number for the country pertaining to your SIM card. For example, if you have an Italian SIM card, your number will be a local Italian cell phone number.

Can somebody else use my SIM card?
Anyone can use your card. If you lose your phone with the SIM card inside, you can usually call customer service to deactivate the card so that nobody can use the remaining credit, though they won't be able to issue you a new card. You can also safely lend your phone and SIM card to friends without worrying about incurring any out-of-pocket costs. If they need more talk time, they can simply add some by purchasing a recharge card and using it with your SIM card.

Can I retain my Pakistan cellular phone number?

Unfortunately you cannot. We recommend that you leave your overseas cellular number on your domestic voice mail. This way, whoever needs to reach you while you are overseas can still do so? You might be able to forward calls, providing someone can program forwarding for you back in the Pakistan. The problem with this is that all wrong numbers, telemarketers and everyone else you don't want to hear from when you're abroad will be able to reach you and that will end up being a nuisance.

Will I have voicemail?

Most GSM phones have voicemail capacity, but it depends on what services are available through the local provider. In almost all cases voicemail is included with your service.

What about text messaging or emails?

These options depend on the local service provider but nowadays they are common features and offered by almost all the overseas carriers.

Can I use multiple SIM cards with my phone?

Since we offer only unlocked phones, you can swap SIM cards as often as you like. However if you are traveling to multiple countries, you might consider that each SIM card has its own unique phone number. In the case of traveling to many countries during one trip, an International SIM card is the optimal choice for many travelers as you keep the same phone number regardless of your position on the globe. Note that you will be roaming when outside the country of origin for the card.

If I run out of call credit, do I buy another SIM card?

NO! Remember, the SIM card is the "brains" of your phone and is rechargeable. Once you have a SIM card all you need to do is add credit for more talk time. Make sure that you do not wait beyond the service life of your SIM card to add more call credit.

How do I add more "talk time" to my SIM card?

In prepaid phone lingo, adding more talk time is known as "recharging" or "topping-up" a SIM card. Recharging a SIM card is as easy as entering a code number into the handset. Recharge voucher cards with recharge codes on them can be purchased at many convenience stores, magazine kiosks and cell phone stores. They are also often found at post offices, train stations and airports. Please note that you can only purchase recharge cards within the country of origin. (If you have a country-specific SIM for Germany, for instance, you can only purchase recharge cards for that SIM card within Germany.)

Will my country-specific SIM card work outside the country of origin?

When you use a country-specific SIM card outside of its home country, this is known as "roaming". While this is often possible to do, there are some problems that make this undesirable for longer side-trips. First of all, the rates are much more expensive for making local and international calls and you don't get free incoming calls. Also, if you run out of credit, you rarely can purchase recharge vouchers outside of the country of origin.

How do I roam with my country-specific SIM card?

First of all, Cellular Abroad does not support roaming out-of-country with country-specific SIM cards. (There are too many possibilities and variables for us to do this adequately.) That said, here are some rules-of-thumb for you to use if you plan to roam:

1. Call customer service for your SIM card carrier to request or confirm that your SIM has roaming capabilities enabled. Roaming with some SIM cards may NOT be possible at all.
2. Make sure to ask customer service if there are any variations in dialing to or from your number when roaming. (Perhaps the use of a different country code or dialing prefix, etc.)
3. Ask customer service to provide dialing rates for making and receiving calls when roaming for all scenarios of interest
4. Make sure you have a good guesstimate of how much time you'll use the phone when roaming.
5. Buy and apply adequate call credits (via recharge vouchers) for use when roaming. You may want to purchase a "backup" recharge voucher to use in case your SIM card runs out of call credits when you are roaming.

How do I know how much call credit I have remaining?

You can always check your remaining call credit. The instructions vary from country to country and are always provided with the SIM cards you purchase through us. Typically you either call a special number or send an SMS message and the carrier answers back with your remaining credit.

I am currently overseas and I charged the phone and inserted the SIM card, but I still can't make any calls. What's wrong?

Generally this problem can be rectified by changing the band the phone is currently operating on. For example, if you are in Europe and the band of your GSM cell phone is set to the 1900 frequency, you will need to reset it to the 900/1800 frequency for it to work properly. Usually you'll know you're using the incorrect frequency if you do not a get a signal on the LCD display of your cell phone. However this is not always the case as it could also mean you are simply not in a good coverage area or indoors. If you are roaming and your carrier has different roaming agreements with other carriers, you may be able to improve your coverage by manually switching GSM networks. For details on how to do this, consult your manual.

What if my cell phone or SIM card doesn't work?

It is rare that one of our cell phones wouldn't work and extremely rare for a SIM card not to work. We personally test all of our phones prior to sending them out to ensure quality

service and no defects. You can double-check this after you receive your cell phone and a SIM card for your overseas trip. Less than 1% of all GSM cellular phones are defective and less than 1 in 10,000 SIM cards are defective. If for some reason a phone or SIM card purchased from Cellular Abroad proves defective, it will be replaced ASAP. If you encounter problems while on the road, you will first want to determine if the problem is a network problem or if it is hardware-related. If you can use someone else's GSM phone and reproduce the problem, then you should contact the local carrier to see if there is a problem with the network.

Why can’t I view a video taken with my phone in media players?

The code required to view these files may not be associated with your media player. You can always view the video with the Video Studio in mobile Phone Tools.

When I connect to my A780 or E680 phone via BT the Mobile Explorer, Image Studio, Melody Studio, and Video Studio are not available in the MMC.

That is because file transfer is not supported over BT with those phones.

When I connect to my phone using the Motorola BT adapter (DC600) the feature to transfer files to the phone has been disabled.

That is because file transfer is not supported over the DC600 BT adapter.

When I try to open the phonebook or do synchronization I get a PhoneBK.exe error

This could be caused by a know conflict between Win Fax Pro 10.00 and Outlook 2002.

I have XP service pack 2 and my BT connection is not working.
Go to www.bvrp.com/customers/motorola and click on the XPsp2 and BT.pdf document for setup instructions.

Why do I get an error when trying to transfer files from my phone to the PC

If you get an error like "white space not allowed at this location" check for file names and make sure they do not contain more then 36 characters (including. and file extension) If

you get an error like "A semi colon character was expected" check your file names for a “&” character. This is a special character and is not allowed in a file name.

Why can’t I save music files as .mP3’s?

In order to save files in mP3 format you must have an mP3 encoding capable codec installed on your system. This codec is standard with Win XP but your PC manufacturer may have decided not to include it with your version. Also other applications may have replaced this codec with a decode only version. For more information look here:
http://mp3decoders.mp3-tech.org/decoders_acm.html

Why can I not connect to the internet or my VPN?

In order to use Mobile Phone Tools and your Motorola mobile phone to access a High Speed GSM based data/Internet connection you should have the following:

1. A fast speed data package service (GPRS, EDGE, 3G, etc...) that can be provided sometimes at an extra cost from your mobile phone service provider. Once this data package service is active, your mobile phone will have an APN (Access Point Network) support. Mobile Phone tools will use that automatically to connect to the internet.
2. **NOTE:** Some mobile phone service providers support 2 APN's. One provides access to the regular internet and one that provides access to a **VPN (Virtual Private Networking)**. **VPN** is a means by which certain authorized individuals, such as remote employees have secure access to an organization's **intranet** by means of an extranet, a part of the internal network that is accessible via the Internet. If that is the case you would need to contact your mobile phone service provider and make sure you do have the appropriate VPN access.

Why can’t I make a data connection on Win98 se?

There maybe a problem with saving your password. When you start Windows 98se if you click cancel when asked for a password this can cause this problem. To correct this issue uses your password or follow the process outlined here.
http://support.microsoft.com/default.aspx?scid=kb;en-us;148925

What versions of Lotus Notes does mPT work with?

mPT works with Notes version 5.0,5.01,6.0,and 6.01

If I export my contacts I can not read them in the exported file.

This is can be an issue with double byte languages, to configure your computer to read this file properly you need to add support for Arial Unicode MS font.

1. Quit all programs.
2. In **Control Panel**, double-click the **Add/Remove Programs** icon.
3. Do one of the following:
4. If you installed your Microsoft Office program as part of an Office package, click **Microsoft Office** in the **currently installed programs**
5. box, and then click **Change**.
6. If you installed your Office program individually, click the name of your
7. program in the **currently installed programs** box, and then click
8. **Change**.
9. In the **Microsoft Office Setup** dialog box, click **Add or Remove Features**, and then click **next**.
10. Next to **Office Shared Features**, click the plus sign (+).
11. Next to **International Support**, click the plus sign (+).
12. Click the icon next to **Universal Font**, and then select the installation option you want.

Why can’t I read received picture messages with mPT?

Not all phone models support this functionality. If you phone supports pictures messages you may notice that these messages will be displayed as unreadable data in your Mpt inbox.

Why can’t I open an image file that I have transferred to my phone?

Some phone models limit the file size and picture size that can be opened on the phone.Try cropping, resizing, or reducing the color depth of the image before you transfer it to the phone.

Why do the WAV files I upload to my phone sound bad?

MP3 files that are converted into .WAV format using Mobile PhoneTools Melody Manager will become distorted after being transferred to your mobile phone, resulting in

poor audio quality. You will also be unable to set these wav files as ring tones in your mobile phone. It is recommended that you do not use the Mobile Phone Tools Melody Manager for this purpose and that you instead transfer MP3 files from your PC to your mobile phone using the Mobile Explorer view within Mobile Phone Tools.

Why doesn't mPT notify me of incoming calls?

Certain phone models do not support notifying external applications of ring events.

Why can't I end a voice call with mPT?

Certain phone models are not compatible with this command in mPT

Why do SMS messages that have been previously read report as new in mPT?

Messages that have not been read previously by mPT will be display as new regardless of their status in the phone.

Why is the send button in the SMS window grayed out?

There are 2 possibilities that can cause this; the "Number" field has not been correctly entered or no service center has been selected.

How do I select a SMS service center? (GSM/GPRS phone only)

The SMS service center can be selected through the pull-down menu in the SMS window. If you service provider is not listed you can enter one manually.

How do I enter my service provider manually?

From the main screen select Menu/Setup/SMS Configuration. From the SMS Configuration window select "New". Select your country and enter your providers name and SMS service center number. * Note: If you have a CDMA or TDMA phone you can enter "NA" into the number field.

My phone supports EMS why can't I send EMS messages with mPT?

Certain models do not support sending EMS messages with an external application. Check your user manual to see if your phone supports EMS functions.

Why does the number of characters per SMS message sometimes change?

Certain characters require special encoding, which require more space so the number of characters per message will go down to accommodate special characters.

When I click on the calendar button Outlook opens, why?

You have selected Outlook as your PIM. If Outlook was already running when you clicked on the button, Outlook will become the active application but it will remain in the same view. If Outlook was not running, Outlook will be opened to the calendar view.

I selected the wrong PIM during installation, how can I change PIMs?
You will need to uninstall and then reinstall mPT.

Why does it take a long time to read my contacts from my PIM?

If you are using MS Exchange and your contacts are stored on a server it can take a long time to read the contacts from the server. This is expected behavior with Exchange.

When I connect to a data network with mobile Phone Tools the connection icon in the lower right hand part of my screen says 115,000 K. Is this true?

Not necessarily. The speed indicated in Windows is the "Port Speed" that Windows has used to connect to the mobile phone. It is not necessarily the speed, which you are connected to the Internet.

When Dialing numbers from my PC to my cell phone, it never sends the area code.

Mobile Phone Tools is set to use Windows Dialing Properties. To correct this, go to Setup/General Setup. Click on the Location tab and change to Phone Tools dialing properties.

As a precaution, how do I back up my data before completely uninstalling your software?

Before doing anything else, make sure that your hidden files are displayed:

1. For Windows 2000 or XP:- In the Windows Explorer, choose "Tools/Folder Options..." then click the "View" tab.- Check "Show hidden files and folders". And click OK.
2. For Windows 95, 98, Millennium, and NT4:

- In the Windows Explorer, choose "View/Folder Options..." then click the "View" tab.- Check "Show hidden files and folders". And click OK.

Back up your data.- Create a backup folder (on the "Desktop", for instance).

- In the Windows Explorer, go to the "C:\Program Files\Mobile Phone Tools" folder.- Then copy the "Document", "Poste00" and "Fichiers joints" folders to your backup folder.- For the phonebook, copy the "Phonebk.dbf", "Phonebk.pkx", and "Phonebk.pkg" files to your backup folder.(If you have renamed your phonebooks, copy the *.dbf, *.pkx, and *.pkg files).

When sending a fax, the GSM dials then hangs up. What should I do?

Faxes are stored in the Outbox, with the "Delayed transmission" report and the "Transmission timeout" diagnostics.
Verify the modem driver
On the BVRP Web site, check that the GSM you are using is compatible and is selected correctly
in the software.Verify the fax option
Check with your telephone operator that you have a Fax/Data subscription.

How do I change the PIN code number and security number?	On your Nokia phone, select Menu --> Settings --> Security Settings --> Change access codes --> Change pin code, then change security code
How long do I need to charge my battery for the 1st time on my Nokia Phone? And how frequently do I need to charge my battery there after?	You will need to charge for about 1 1/2 hrs to 2 hrs until the battery bar is full. After which a battery will need to be charged when the battery bar show low levels.

Which Nokia phones is tri-band?	Nokia 6100, Nokia 6610, Nokia 7210, Nokia 3650 and Nokia 7250 are tri-band phones.
How do I download PC suite and modem driver for my Nokia phone?	Simply go to Phones Support and select your phone model.
What is a "PUK" code?	PUK code stands for Personal Unblocking code. It is given by your entered your PIN number wrongly for three times

Marketing

Marketing is the craft of linking the producers (or potential producers) of a product or service with customers, both existing and potential. Some form of marketing arises naturally in all capitalist societies but is not limited to capitalist societies. Marketing techniques are also applied in politics, religion, personal affairs, and many other aspects of life.

Marketing methods are informed by many of the social sciences, particularly psychology, sociology, and economics. Marketing research underpins these activities. Through advertising, it is also related to many of the creative arts. Successful marketers typically have a customer orientation or focus.

OVERVIEW

In popular usage, the term "marketing" refers to the promotion of products, especially advertising and branding. However, in professional usage the term has a wider meaning. It can be divided into four sections, often called the "*four Ps*," only one of which is promotion. They are:

- **Product** - The Product management aspect of marketing deals with the specifications of the actual good or service, and how it relates to the end-user's needs and wants.
- **Pricing** - This refers to the process of setting a price for a product, including discounts.

- **Promotion** - This includes advertising, sales promotion, publicity, and personal selling, and refers to the various methods of promoting the product, brand, or company.
- **Place** or distribution refers to how the product gets to the customer; for example, point of sale placement or retailing.

These four elements are often referred to as the marketing mix. A marketer will use these variables to craft a marketing plan. For a marketing plan to be successful, the mix of the four "p's" must reflect the wants and desires of the consumers in the target market. Trying to convince a market segment to buy something they don't want is extremely expensive and seldom successful. Marketers depend on marketing research to determine what consumers want and what they are willing to pay for. Marketers hope that this process will give them a sustainable competitive advantage. Marketing management is the practical application of this process.

Some aspects of marketing, especially promotion, are the subject of criticisms.

Sale & Purchase strategies

- Keep in mind the following points while making any sale or purchase transaction to avoid any problem.
  Be fare
- Always present the right picture before the client
- Keep in touch with the market trends
- Keep up to date product information and product lines of various mobile companies
- Keep yourself up dated with the features and faults of various products.
- Be creative
- Make market surveys on regular bases

Safety Measures

1. Mobile Phone use in Petrol Stations – Government and Police have issued a warning about mobile phones - they have reported 3 incidents recently where mobile phones have ignited fumes whilst being answered/ringing during fuel operations:

A phone was placed on the boot lid during refueling, it rang and the ensuing fire destroyed the car and the pump.

2. An individual suffered burns to the face when fumes ignited as he answered a call during fuelling.
3. An individual suffered burns to the thigh and groin as fumes ignited when the phone, which was in his pocket, rang during fuelling. Why did it happen? It is a misconception that Mobile Phones can't ignite fuel/flumes. It is believed that the more modern phones (those that light up when either switched on or when they ring) have enough energy released to provide the spark for ignition.

Learning Points

1. Mobile phones should not be used in filling stations
2. Mobile phones should be turned off before exiting the vehicle when stopping in a filling station.
3. All Road users have a special responsibility for the safety of themselves, their passengers, other road users and pedestrians.
4. NEVER try to use a hand-held mobile phone or device for any reason while driving
5. ONLY ever make or take a hands-free call when you are certain it is completely safe to do so. KEEP conversations short and easy - end calls that become difficult, distracting or stressful immediately.
6. SET UP the advanced functions of your mobile phone device, such as the messaging service, to give yourself time and peace of mind to focus on your driving,
7. When it doubt - switch it OFF Help bring an end to the alarming sight of motorists trying to drive and hold a mobile phone at the same time. It is simply unlawful, unacceptable and unnecessarily dangerous. If you currently have, or are thinking of buying a mobile phone, please consider the purchase of a hands-free kit that you can arrange to have installed in your car. -- Dave Gall, Black heath, London England

Useful tip: If you have a passenger, ask them to manage your mobile calls for you.

Useful tip: Why not give yourself time and concentration for your mobile calls by taking a break from driving and parking safely?

Useful tip: Tell your caller you are driving before you begin your conversation, and that you may need to end your short call at any time.

Useful tip: Voice messaging means you never need miss a call. At the heart of the matter is driver alertness and distraction. It is all too easy to become absorbed in conversation, particularly if it is an important call. "It is far safer not to use any telephone while you are driving - find a safe place to stop first". Remember, on a motorway, parking doesn't mean the hard shoulder which, by law, can only be used in an emergency. Using a mobile phone on a petrol station forecourt is forbidden. As a personal precaution, try not to park conspicuously; lock the doors and secure the windows. If you are driving in your job, always check your employer's guidelines as well.

CATALOGUE OF CELL PHONE PARTS AND ACCESSORIES



ANTENNA SWITCH



INTERNAL ANTENNA



ANTENNA CONNECTOR



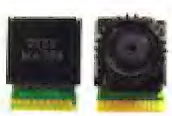
BATTERY CONNECTOR



BATTERY LOCK



BUZZER



INTERNAL CAMERA



CHARGER CONNECTOR



IC







LENS

KEY MEMBRANE



MICROPHONE



SIM READER



EXTERNAL ANTENNA

LCD CONNECTOR



ON/OFF POWER SWITCH



SPEAKER



KEY PAD



SIM HOLDER



ON_OFF BUTTON



LCD



Mobile phone lcd for motorola v180



Mobile phone lcd for
nokia 1100 with board



Mobile phone lcd for
nokia 3300/6800



Mobile phone lcd for nokia 3320 with board



Mobile phone lcd for nokia 3510i/3530 with board



Mobile phone lcd for nokia 5110 with board



Mobile phone lcd for nokia 5210 with board



Mobile phone lcd for nokia 6210 with board



Mobile phone lcd for nokia 6510/6590 with board



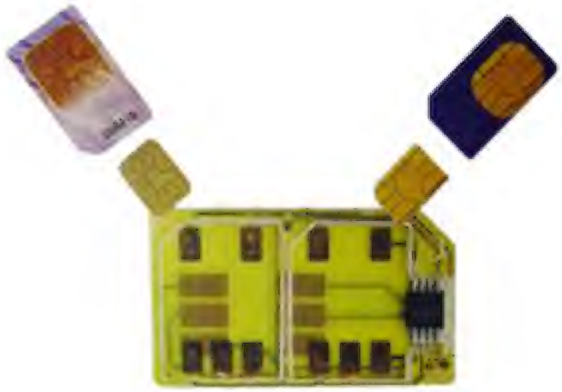
Mobile phone lcd for nokia 6650



Mobile phone lcd for nokia 8910i



Mobile phone lcd for nokia 9210, big lcd



2 IN 1 SIM TOOL ,



Save up to 8 different SIMs to SuperSIM Edit your phonebook in your PC Edit SMS short messages in your PC GSM SIM Pin code (password) Management Edit and change personal Ring Tone Build-in hundreds of midi ring tone for ring tone editing Copy & Backup the phone book and SMS message Between your SIM cards Converient sorting functions High speed decoding USB to RS-232 Cable optional



Save up to 16 different SIMs to SuperSIM Edit your phonebook in your PC Edit SMS short messages in your PC GSM SIM Pin code (password) Management Edit and change personal Ring Tone Build-in hundreds of midi ring tone for ring tone editing Copy & Backup the phone book and SMS message Between your SIM cards Converient sorting functions High speed decoding USB to RS-232 Cable optional

16 IN 1 SIM TOOL



1. Backup and copy the contact lists from SIM CARD in Mobile Phone 2. Save Capability: 8KB (250 Phone records) 3. Easy Operated: don't need to connect with PC or PDA for operating 4. Protect and save all the data in Backup device when the Mobile Phone is missing 5. Data will still exist in Backup device even if the Power supply is off 6. Be able to copy all the information from backup device to any SIM card, even if the users are using the different SIM cards, and from the different cities or countries



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The New-SonyEricsson unlocker is the latest product can unlock the netlock of the newest SE models such as : K500 / K500i / F500 / K700 / K700i / S700 / V800 / Z1010 etc, and it supports upgrade online which made you can do the newest models forever



It can repair software bugs of samsung phones by restoring IMEI, Unlock phone lock and net-lock.



Flash files
Add chinese input
Read/Unlock/Lock(network lock,phone lock)
Change IMEI
Change Language
Change Ring
Change startup logo,etc



Unlock phone
Unlock network
Change IMEI



Victory Eagle 2.0 is updated from Victory Eagle V1.0, and it is one new UNIVERSAL BOX, more powerful and functional. It works with MotoEXP (Motorola), Terminator/DIV-USB (SonyEricsson), UFO Box (Nokia), JIG Box (Samsung), Siemens, Panasonic, Philips, Mitsubishi, Sagem and so on; even it can work for CDMA phones and PHS phones, do flash, update and unlock. Logo Edition, Ring Edition, Standby Edition are all available too.



Cables inlcude with RedboX: - NEC 2xx - NEC 341 / 525 - Maxon Epsilon - Maxon 7xxx Ox2 - Philips 530 - Philips 8xx - Philips 630 more....



It can flash DCT3/DCT4 mobiles and repair software bugs, change language,IMEI,unlock. .With new models



Support Nokia DCT3,unlock,flash(MCU,PPM,PMM,MUG) repair IMEI, DCT4 unlock flash(MCU,PPM,CNT),repair IMEI DCT-L unlock flash (MCU,PPM,PMM,MUG) repair IMEI,WD-2 unlock flash(MCU,PPM,CNT) repair IMEI.Sonyerission unlock flash(AVR,ARM,PDA MOD BT) repair GDFS. all most of Motorola,Samsung,unlock flash . factory default setting.



TWISTER : The Multi-Platform profesional USB-driven Software Suite supports over 250 models



The box support samsung series phone flashing,unlock,change IMEI,
update Eeprom,edit ring etc...



It can flash DCT3/DCT4 mobiles and repair software bugs, change language,IMEI,unlock. .



top speed transaction, more 30% - 40% than other programmer

with UFO, DIV-USB and Samgem solutions in

with property right and original source code

premonitory design for long-term usage

Genius Programmer is working by 1.8v

with portable design like one USB disk only

its adaptors can use for LT48 and UP48 programmer, and can



update online.

It works with all 1.0mm, 0.8mm, 0.75mm and 0.5mm flash IC.



GUNLOCK,FLASHER,REPAIR BOX



Moto C3xx++ Clip



Griffin cable Complete set



More area for soldering with
efficient 350*350mm proportion.
Even the computer mainboard...



- T28, R310, A26x8, T20, T29,
- T39, R520, T65, T68m, T68i,
T200, T300, T310, P800,
- T610, T230, Z600, T630, P900
(all old & NEW versions
including latest versions)
- LATEST UPDATE NOW
SUPPORTS Z200.
- ALSO NOW SUPPORTS
USER LOCK RESET



Universal Battery
Tester/Analyzer for all kinds of
cellular phone's battery



Mobile phone repairing tools,
screw drivers

MODEL NO : RT1



Mobile phone repairing tools,
screw drivers

MODEL NO : RT2



Mobile phone repairing tools,
screw drivers

MODEL NO : RT3



Mobile phone repairing tools,
screw drivers

MODEL NO : RT4



Mobile phone repairing tools,
tools set

MODEL NO : RT5



Mobile phone repairing tools,
tools set

MODEL NO : RT6



Mobile phone repairing tools,
tools set

MODEL NO : RT7



Mobile phone repairing tools,
tools set

MODEL NO : RT8



Mobile phone repairing tools,
tools set

MODEL NO : RT9



Mobile phone repairing tools,
tools set

MODEL NO : RT10



Mobile phone repairing tools,
tools set

MODEL NO : RT11



Mobile phone repairing tools,
tools set

MODEL NO : RT12



Mobile phone repairing tools,
tools set

MODEL NO : RT13



Mobile phone repairing tools,
tools set

MODEL NO : RT14



Mobile phone repairing tools,
tools set

MODEL NO : RT15



Mobile phone repairing tools,
tools set

MODEL NO : RT16



Mobile phone repairing tools,
tools set

MODEL NO : RT17



Mobile phone repairing tools,
tools set

MODEL NO : RT18



Mobile phone repairing tools,
tools set

MODEL NO : RT19



Mobile phone repairing tools,
tools set

MODEL NO : RT20



Mobile phone repairing tools,
tools set

MODEL NO : RT21



Mobile phone repairing tools,
tools set

MODEL NO : RT22



Mobile phone repairing tools,
tools set

MODEL NO : RT23



Mobile phone repairing tools,
tools set

MODEL NO : RT24



Mobile phone repairing tools,
tools set

MODEL NO : RT25



Battery for Nokia
8210/8850/8890/8310/8250
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Nokia
9500
Voltage : 3.75±0.5
mAh : 1500
Resistance : 135



Battery for Ericsson
788(Ni)768//T18/T10/730/738
Voltage : 4.8±0.2
mAh : 750
Resistance : 175



Battery for Ericsson
T28/T29/T29
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Ericsson
T68/T68i
Voltage : 3.6±0.5
mAh : 900
Resistance : 135



Battery for Ericsson
T610/T618
Voltage : 3.6±0.5
mAh : 900
Resistance : 135



Battery for Siemens
1118/A35/C1128/A36
Voltage : 3.75±0.5
mAh : 650
Resistance : 175



Battery for Siemens
S35
Voltage : 3.6±0.5
mAh : 900
Resistance : 135



Battery for Siemens
C2588(Ni)/C25
Voltage : 3.75±0.5
mAh : 650
Resistance : 175



Battery for Siemens
3508/3518/3568/C35
Voltage : 3.75±0.5
mAh : 900
Resistance : 135



Battery for Samsung
A100/A188(Li-ion)
Voltage : 3.75±0.5
mAh : 550
Resistance : 135



Battery for Samsung
A200/A288
Voltage : 3.75±0.5
mAh : 550
Resistance : 135



Battery for Samsung
A300/A308/A388(Li-ion)
Voltage : 3.75±0.5
mAh : 950
Resistance : 135



Battery for Samsung
A408/A400(Li-ion)
Voltage : 3.75±0.5
mAh : 550
Resistance : 135



Battery for Samsung
A300/A308/A388(Li-ion)
Voltage : 3.75±0.5
mAh : 950
Resistance : 135



Battery for Samsung
N628/N620(Li-ion)
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Samsung R208/R220(Li-ion)/R210/R225
Voltage : 3.75±0.5
mAh : 900
Resistance : 135



Battery for Samsung T108T/T100(Li-ion)
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Motorola C350
Voltage : 3.75±0.5
mAh : 650
Resistance : 135



Battery for Samsung T191
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Samsung V60
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Motorola V70
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Panasonic GD90
Voltage : 3.75±0.5
mAh : 750
Resistance : 135



Battery for Motorola GD92
Voltage : 3.75±0.5
mAh : 650
Resistance : 135



Battery for Sagem
Sagem 930
Voltage : 3.75±0.5
mAh : 750
Resistance : 175



Battery for Sony
Z18M/Z28/Z38(Li-ion)
Voltage : 3.75±0.5
mAh : 750
Resistance : 140



Battery for
Nokia 3210
Voltage : 3.75±0.5
mAh : 1200
Resistance : 135



Battery for Nokia
3310/3330/3410/3510
Voltage : 3.75±0.5
mAh : 950
Resistance : 135



Battery for Nokia
6110T(Ni)/5110/5150
Voltage : 4.8±0.2
mAh : 1100
Resistance : 175



Battery for Nokia
6100/3650
Voltage : 3.75±0.5
mAh : 550
Resistance : 135



Battery for Nokia
6110T vibration(Li-ion)
Voltage : 3.75±0.5
mAh : 1100
Resistance : 135



Battery for Nokia
7210/6610/2100
Voltage : 3.75±0.5
mAh : 650
Resistance : 135

COMMUNICATION GLOSSARY

A	
A Carrier	Most areas of the Pakistan have two cellular carriers, each of which operates on a different frequency band. One is designated the "A" carrier (non-wireline carrier) and the other is designated the "B" carrier. In some markets there may be only one carrier which may be "A" or "B".
A/B Switching	Most cellular phones have the ability to switch to the "A" or the "B" frequency bands. This feature is useful when roaming outside your home coverage area.
Access Fee	A monthly charge for the ability to connect to a wireless network. This fee is assessed monthly whether the phone is actually used or not.
Activation	Configuration of a wireless phone so that it is ready to be used to transmit and receive calls on the wireless network.
Activation Fee	A one-time up-front charge for activation of a wireless phone.
Airtime	Total time that a wireless phone is in connected and in use for talking. This includes use for calls both received and placed.
Alphanumeric Display	A display, usually LCD, that has the ability to display both text and numbers. Most often found on the front of a wireless handset or pager.
AMPS (Advanced Mobile Phone Service)	An analog cellular phone service standard.
Analog	A method of modulating radio signals so that they can carry information such as voice or data.
Antenna	A device that facilitates the transmission and reception of radio signals.
APC (Adaptive Power Control)	A feature of some wireless handsets that helps reduce power consumption to increase battery charge life.

Area Code	A three digit telephone number prefix assigned to a calling area.
Authentication	A feature used to reduce fraud by confirming the identity of a phone to the wireless network.
Automatic Call Delivery	A service feature that allows a user to receive calls when roaming outside of the phone's home coverage area.
B	
B Carrier	Most areas of the Pakistan have two cellular carriers, each of which operates on a different frequency band. One is designated the "A" carrier and the other is designated the "B" carrier (wireline carrier). In some markets there may be only one carrier which may be "A" or "B".
Bandwidth	Describes the transmission capacity of a medium in terms of a range of frequencies. A greater bandwidth indicates the ability to transmit a greater amount of data over a given period of time.
Bluetooth	A short range wireless protocol meant to allow mobile devices to share information and applications without the worry of cables or interface incompatibilities. The name refers to a Viking King who unified Denmark. Operates at 2.4 GHz, see bluetooth.com.
BREW (Binary Runtime Environment for Wireless)	A QUALCOMM programming platform designed to facilitate the development and use of data applications that can function on any CDMA-based wireless device. Common applications include games and software for corporate functions. See J2ME for a similar technology from Sun Microsystems.
Broadband	Describes a communications medium capable of transmitting a relatively large amount of data over a given period of time. A communications channel of high bandwidth.

BTA (Basic Trading Area)	A geographic region defined by a group of counties that surround a city, which is the area's basic trading center. The boundaries of each BTA were formulated by Rand McNally & Co. and are used by the FCC determine service areas for PCS wireless licenses
C	
Call Forwarding	A feature that allows the transfer of incoming calls to another number of the users choice.
Call Setup	Activity that occurs in order to establish a call connection between a wireless handset and the wireless system.
Call Waiting	A feature that allows a user to be notified of another incoming call while a call is already in progress, and gives the user the ability to answer the second call while the first call remains on hold.
Caller ID	A feature that displays a caller's telephone number and/or name before the call is answered.
Carrier	A company that provides telecommunications services.
CDMA (Code Division Multiple Access)	A digital communication technology used by some carriers to provide PCS service. Also known as IS-95A or cdmaOne. Other technologies used are TDMA and GSM.
CDMA2000 1X (Also 1xRTT)	A 3G wireless communications standard evolved from CDMA technology. It has double the voice traffic capacity of CDMA and provides peak data rates of 153 kbps.
CDMA2000 1xEV-DO (and 1xEV-DV)	A 3G wireless communications standard further evolved from CDMA2000 technology. It is a standard optimized for data transmission providing a peak data rate of 2.4 Mbps with a typical user experience of 300 - 800 kbps. 1xEV-DV is optimized for both data and voice transmissions.
CDPD (Cellular Digital Packet Data)	A technology for transmitting data over analog cellular networks. Requires a special modem and the wireless

	carriers' network must be upgraded to accommodate such data transmissions.
Cell	The area surrounding a cell site. The area in which calls are handled by a particular cell site.
Cell Site	The transmission and reception equipment, including the base station antenna, that connects a cellular phone to the network.
Cellular	The type of wireless communication that is most familiar to mobile phones users. Called 'cellular' because the system uses many base stations to divide a service area into multiple 'cells'. Cellular calls are transferred from base station to base station as a user travels from cell to cell.
CO (Central Office)	A connection point between the wireless phone system at the MTSO and the landline phone system at the PSTN.
Clone (Cloning)	A wireless phone that has been programmed to mimic another wireless phone. Often used to defraud a wireless carrier by placing illegal calls without any intention of payment.
Coverage Area	The geographic area served by a wireless system. Same as Service Area.
Cross-talk	A signal leak from one channel to another - often the cause of noise and distortion.
D	
Decibel (dB)	A unit of measure used to express relative difference in power or intensity of sound.
Digital	A method of encoding information using a binary code of 0s and 1s. Most newer wireless phones and networks use digital technology.
Dual band	A feature on some wireless phones that allows the handset to operate using either the 800 MHz cellular or the 1900

	MHz PCS frequencies.
Dual mode	A feature on some wireless phones that allows the handset to operate on both analog and digital networks.
Duplex	As in ordinary telephone service, a characteristic of a communications system where simultaneous transmission and reception is possible.
E	
E-mail	The ability to send and receive text messages through a wireless handset.
EDGE (Enhanced Data for GSM Evolution)	A further development of the GSM protocol designed to handle data at speeds up to 384 Kbps. Considered to be 3G wireless technology.
ESMR (Enhanced Specialized Mobile Radio)	Using frequency bands originally allocated for two-way dispatch services, companies such as Nextel and Southern LINC have built digital mobile phone services similar to cellular and PCS systems.
ESN (Electronic Serial Number)	The unique serial number of a cellular phone that identifies it to the cellular system for the purpose and placing and receiving calls.
F	
FAA (Federal Allocation Authority)	A Pakistan government agency responsible for regulating communications industries.
Fingerprinting	See Radio-frequency fingerprinting.
Follow-Me Roaming	The ability of a wireless system to forward incoming calls to a handset that is roaming outside its home service area without any pre-notification to the wireless carrier.
G	
GSM (Global Standard	A digital communication technology used by some carriers

for Mobile)	to provide PCS service. Other technologies used are CDMA and TDMA.
GPRS (General Packet Radio Service)	An emerging technology standard for high speed data transmission over GSM networks.
H	
Handoff	The transfer of a wireless call in progress from one transmission site to another site without disconnection.
Hands-Free Speakerphone	A feature of some wireless phones that allows the users to talk and listen to calls without holding the phone against their head.
Handset	Any hand held device used to transmit and receive calls from a wireless system. Also known as a wireless phone, a cellular phone, a mobile phone, a PCS phone and many other terms.
Handshake(ing)	Signals between a wireless phone and a wireless system to accomplish call setup.
Home Coverage Area	A designated area within which cellular calls are local and do not incur roaming or long distance charges.
HomeRF	A digital wireless communications protocol designed for the transport of voice and multimedia content between consumer electronic devices(including PCs) in a residential setting. Operates at 2.4 GH.
I	
IMT2000	A set of proposals for standards defining 3G wireless network performance. An effort from the ITU (International Telecommunications Union), an organization of the United Nations.
Interconnection Fee	A fee charged for calls from wireless phones that must be routed to landline phones.

J	
J2ME (Java 2 Micro Edition)	A Java environment optimized to run applications on devices small devices with limited processing power and memory. See BREW for a similar technology from QUALCOMM
L	
Landline	Traditional wired telephone service.
LCD (Liquid Crystal Display)	A flat panel screen used to display numbers and/or characters. Often found on a wireless handset.
LED (Light Emitting Diode)	A light on a handset to alert the user of various conditions.
LMDS (Local Multipoint Distribution System)	A fixed, broadband wireless system used for voice and interactive data. Generally used as a lower cost alternative to landline connections for businesses and others requiring high bandwidth connections to public networks.
M	
Memory Dialing	A feature of a wireless phone that allows multiple numbers to be stored in the phone itself for quick dialing by pressing one or two buttons.
MMDS (Multipoint Multichannel Distribution Service)	Often referred to as 'wireless cable' as it is a wireless system used to distribute cable television and other broadband signals to multiple users by way of a single transmitter.
MMS (Multimedia Messaging Service)	Similar to SMS, but in addition to plain text, MMS messages may include multimedia elements such as pictures, video and audio. These multimedia elements are included in the message, not as attachments as with email.
Monophonic Ringtones	Ringtones made up of a series of sequential beeps at different frequencies. These sound like the beeping of a computer, and the tunes are simple because the phone can only produce one sound (beep) at a time.

MTSO (Mobile Telephone Switching Office)	An office housing switches and computers to which all cell sites in an area are connected for the purpose of eventual connection to the PSTN. The MTSO handles the connection, tracking, status and billing of all wireless call activity in an assigned area.
N	
NAM (Number Assignment Module)	A component of a wireless phone that holds in electronic memory the telephone number and ESN of the phone.
No Answer Transfer	A feature of a wireless service that if a call is not answered in a specified number of rings, it will be transferred to another phone number of the user's choice.
No Service Indicator	A feature of wireless phones that tells the user that wireless service is unavailable in a particular location. Usually an LED on the handset.
O	
Off Peak	Any time of day, as determined by a wireless carrier, when there is lower communications traffic on the system. Carriers make this distinction to offer lower rates during these periods when demand is low.
P	
Paging	A feature of a wireless device that allows reception of a signal or alphanumeric message.
PCS (Personal Communication Services)	Used to describe a newer class of wireless communications services recently authorized by the FCC. PCS systems use a different radio frequency(the 1.9 GHz band) than cellular phones and generally use all digital technology for transmission and reception.
Peak Period(s)	Any time of day, as determined by a wireless carrier, when there is high levels of communications traffic on the system.
POTS (Plain-Old-	Another name for traditional wired, land based telephone

Telephone-Service)	service.
Polyphonic Ringtones	Phones that play polyphonic ringtones have the ability to produce 16 separate sounds at once. This makes for music that is much richer and the tunes sound more like the music you know.
Prepaid Cellular/Wireless	A service plan offered by some wireless carriers that allows subscribers to pay in advance for wireless service.
PRL (Preferred Roaming List)	A database in a CDMA based wireless phone that tells it how to find and connect to locally available wireless network(s). The function of the PRL is most important when a phone is outside its home network and must seek out an alternate network. The PRL in a phone can be periodically updated to account for changes in wireless networks that the phone may encounter.
PSTN (Public Switched Telephone Network)	A formal name for the world-wide telephone network.
R	
Radio-frequency fingerprinting	An electronic process that identifies each individual wireless handset by examining its unique radio transmission characteristics. Fingerprinting is used to reduce fraud since the illegal phone can not duplicate the legal phone's radio-frequency fingerprint.
RF (Radio Frequency)	A radio signal.
RFI (Radio Frequency Interference)	An undesired radio signal that interferes with a radio communications signal causing extraneous noise and/or signal dropouts.
RF Noise	Undesired radio signals that alters a radio communications signal causing extraneous sounds during transmission and/or reception.
Ringback Tone	The tone you hear (in the earpiece) when you place a call

	and are waiting for the phone to be answered. The standard tone is usually an on and off ringing sound. On some wireless systems, users have the ability to choose the tone heard when other users dial their number.
Ringtone	A sound from your phone used to signal an incoming call or message. On most newer phones additional sounds can be downloaded from the wireless system or by data cable. These sounds can take the form of anything you want, the most popular sounds are music.
Roaming	Using your wireless phone in an area outside its home coverage area. There is usually an additional charge for roaming.
Roaming Agreement	A agreement among wireless carriers allowing users to use their phone on systems other their own home systems. Roaming Fee charged for roaming.
S	
Service Area	The geographic area served by a wireless system. Same as Coverage Area.
Service plan	A contract between a wireless carrier and a wireless subscriber that details the terms of the wireless service including rates for activation, access and per minute usage.
Sensitivity	A measure of a receiver's ability to viably receive weak radio signals.
Signal-to-noise ratio	A measure of the power of a signal versus noise. A lower ratio means there is more noise relative to signal.
SMS (Short Messaging System)	A feature of PCS phones(primarily GSM) that allows users to receive and sometimes transmit short text messages using their wireless phone.
Spectrum	The entire range electromagnetic frequencies.
Spread Spectrum	A communications technology where a signal is transmitted

	over a broad range of frequencies and then re-assembled when received.
Standby Time	The time a phone is on but not actively transmitting or receiving a call.
Subscriber	A cellular phone user.
System Selection Switch	A feature of some cellular phones that allows switching between 'A' and 'B' cellular carriers. This feature is often used when roaming.
T	
T9® Text Input	A feature built into many phones that allows you to use one key press per letter when entering text on your wireless phone. T9 helps make entering text on a limited keypad quick and easy.
Talk Time	The time a phone is on and actively transmitting or receiving a call.
TDMA (Time Division Multiple Access)	A digital communication technology used by some carriers to provide PCS service. Other technologies used are CDMA and GSM.
3G (Third Generation Wireless)	The next generation of wireless communications beyond today's digital PCS technologies. When available, 3G wireless technologies will allow for much higher transmission rates to wireless devices leading to more useful services and a better user experience.
Toll Charges	Charges for placing long distance calls.
Toll-Free Calling Area	An area in which calls can be placed without incurring long distance charges.
U	
UMTS (Universal Mobile	An evolution of GSM technology to 3G. The underlying transmission standard is WCDMA.

Telecommunications System)	
V	
Voice-activated Dialing	A feature that allows users to speak words into a wireless phone to cause it to dial pre-programmed telephone numbers without using the buttons.
Voice Mail	A system that answers calls and allows users to reply to, save, delete or forward messages.
W	
WAP (Wireless Application Protocol)	A global protocol used in many newer wireless devices that allows the user to view and interact with data services. Generally used as a means to view Internet web pages using the limited transmission capacity and small display screens of portable wireless devices.
WCDMA (Wideband CDMA)	A 3G wireless communications standard evolved from CDMA. The standard, often called UMTS, uses wider 5 MHz channels(vs. 1.25 MHz for CDMA) for increased voice traffic capacity and peak data rates of 384 kbps.
Wi-Fi	A wireless data networking protocol generally used connect PCs and laptops to a network. Also know as 802.11b and WLAN(Wireless LAN), it is the most common means of wireless networking and operates at 2.4 GHz.
Wireless Carrier	A company that provides wireless telecommunications services.
WLL (Wireless Local Loop)	A wireless system meant to bypass a local landline telephone system. A home or businesses phone system is connected to the public network by a wireless carrier instead of by the traditional local phone company.

The most popular terms...

The following terms relate to the abbreviations, or jargon we get asked about most:

Bluetooth

Bluetooth is a handy technology that allows devices to talk to one another when close. As and example, you may have Bluetooth on your phone, and when in the car use this to talk to the carphone without having to plug in your phone.

EMS

EMS standard for Enhanced Messaging Service. It is system that has evolved from the standard SMS messaging you my be used to, and allows standard ringtones and graphics to be sent to and between phones.

GPRS

General Packed Radio Service. GPRS is a data upgrade for GSM networks, allowing a data transfer rate of up to 115kps and always on availablity. Now being used for MMS multimedia messaging by some networks.

MMS

MMS stands for Multimedia Messaging Servoce. MMS allows you to send colour images, graphics and audio files like polyphonic ringtones along with your text messages.

Polyphonic

Polyphonic comes from the word polyphony, meaning "many sounds". Music that has many notes sounding together, either in a chordal, or countrapuntal setting.

Polyphonic ringtones vary in specification from phone to phone, but all polyphonic phones support the playing of more than one note together, so your ringtone is generally more musical.

On the downside, because the ringtones are played 'musically' they usually difficult to here in noisy environments. Some manufacturers like Samsung have taken steps to

improve this by making their ringtones especially loud, whilst others like Sony Ericsson have retained the 'beep' ringtones in their T300 handset in addition to the polyphonic tones so you can choose.

RTTTL

Ring Tone Text Transfer Language.

A text format designed to allow people to save standard (non-polyphonic) ringtones. Used by most internet sites for Nokia ringtones and by the Ringtone Converter so you can use RTTTL ringtones with almost any make or model of phone.

SMAF (mmf)

Synthetic Mobile Music Application Format.

Used in some cell phones including phones from Samsung and Sharp for polyphonic ringtone support. Filenames usually end in .mmf and are downloaded to the handset using a cable, IrDA or download by wap.

Other popular jargon...

Analogue

The traditional way to send calls through the air to cell phones. Still used widely in areas where coverage over large areas is required, however in most densely populated countries and locations analog has generally replaced by digital phone networks which generally offer better clarity.

Caller Display (CLI)

Also know as CLI, or Calling Line Identification. Anyone with a digital mobile will know what caller display is immediately, it used to be groundbreaking, but now it is commonplace. The CLI system allows the user of a phone to see who is calling before choosing if they should accept or decline the call.

DECT

Digital Enhanced Cordless Telecommunication. DECT is a standard for cordless phones. We list it here as some Sagem phones used a combined GSM and DECT setup

to allow you to use your mobile phone at home on your landline. It was a good idea, but unfortunately it dones look like it took off as recent Sagem models do not seem to have the facility.

DECT uses 120 channels over 10 frequencies, and gives better quality calls than traditional analogue home phones. Typically most DECT phones have a range of about 30 metres from their base station.

Digital

Digital is often banded about as a better alternative to Analogue. With a digital handset speech is sampled to create a binary series of ones and noughts which can be transmitted, and then decoded at the other end. The advantages of this to the network operator are immediate as more calls can be compressed into the same amount of free air space, but their are advantages to the user as well. As less data is flying, and the data can be corrected for errors, quality is improved, and additional services like caller id and text messaging can also tag onto the messages.

Picture messaging is now starting to take off, and the next generation of digital mobile phones, known as 3G, should feature innovations like streaming video from one handset to another.

Dual Band / Triple Band

Dual and triple band phones started to appear in the late 90's when roaming started to become a realistic proposition. Dual band phones usually allow your phone to work on networks in the GSM900 and GSM1800 bands, allowing you to use your phone in most countries worldwide.

The exception is the USA, where you need a Triple band phone to roam as the GSM standard in the states is GSM1900. Even then in remote areas you may find GSM1900 is not yet supported as the USA is a big place, and GSM networks are better suited to densely populated areas, so if you are planning to roam throughout the States you may be better buying a pre-pay package such as Virgin Mobile on a CDMA network for more coverage than a triple band phone can offer at the time of writing.

EFR

EFR standard for Enhanced Full Rate. It is a voice coding system designed to improve the voice quality on cell phones. For EFR to work it must be supported by the phone networkand your handset.

ETSI

The European Telecommunications Standard Institute. The ETSI wrote the specifications for GSM and DECT.

HSCSD

High Speed Circuit Switched Data is an enhancement to standard GSM networks allowing higher data speeds by combining data slots. Requires support by the network and phone, such as the Nokia card phone.

IMEI

International Mobile Equipment Identity. A unique serial number for your phone.

J2ME

J2ME is a micro edition of Java 2 used for smaller devices with limited memory, such as mobile phones and PDAs. It allows developers to write software for mobiles, expect to see great games on a mobile near you very soon!

Roaming

Roaming allows you to use your mobile phone on other networks other than the one you pay. Usually quite expensive, but very handy when you are on your holidays and want to make someone a little jealous!

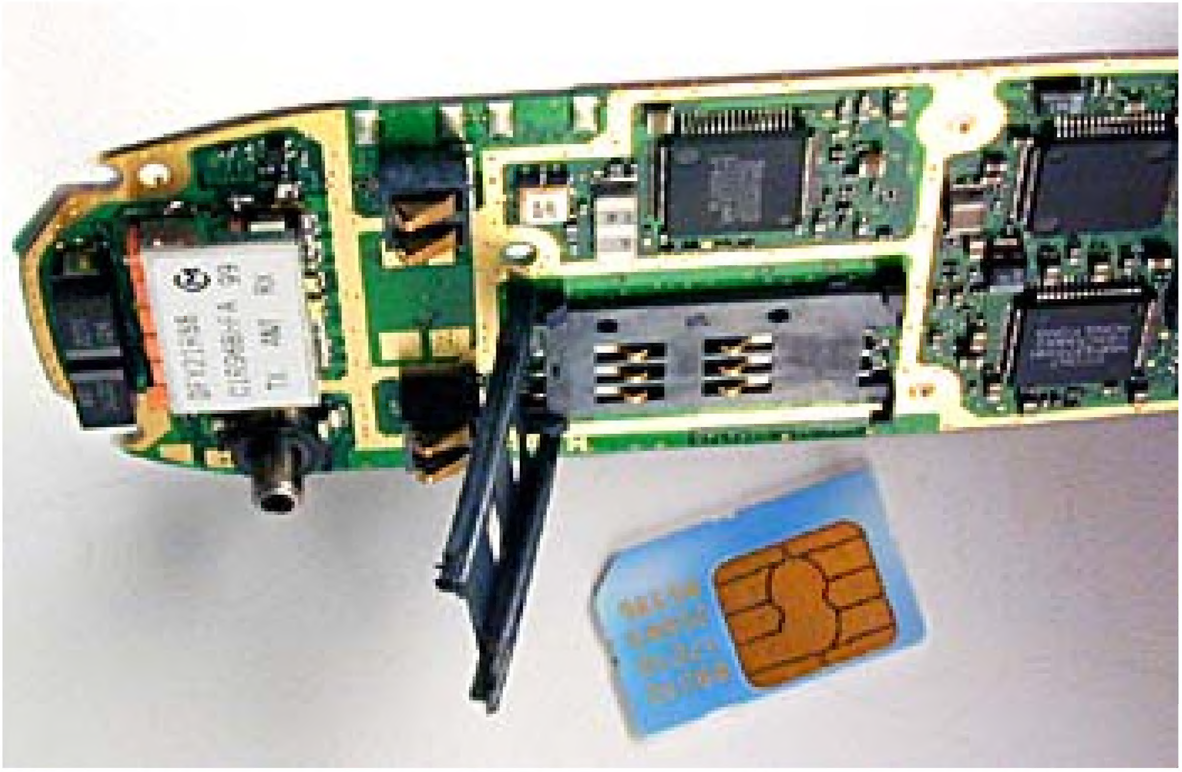
SIM (Card)

Subscriber Identity Module. The name for the small smart card used in your phone. Sim cards used to be the same size as credit cards, but with shrinking phone sizes, the Sim was re-worked to a small card about the size of a penny or cent. The Sim card stored your phone number.

Following are Comments / proposals / suggestions about existing curriculum.

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RM / BOM / VTI / Trainee









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